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ABSTRACT

This research synthesis reviews how employers, educators, and professional and labor organizations have adapted general work readiness, industry core, occupational cluster, and specific occupational skills to design and implement a skill standard system. Its primary goal is to describe and analyze a continuum of alternatives for conceptualizing skill standards. Following an introduction, section 2 reviews private- and public-sector efforts to identify and draft academic and employability skill standards. It considers the relationship between industry and academic skill standards and the requirements of high performance work organizations on skill standard development and implementation. Section 3 reviews proposals for developing an industry-based skill standard system for education and describes some approaches that educators are presently using to implement comprehensive skill standard systems. Section 4 characterizes different frameworks that standard developers use to formulate and organize occupational cluster standards for education. It uses clusters from selected educational programs and national, state, and industry standards projects to illustrate issues related to standard development and implementation. Section 5 examines how developers define and implement occupationally specific standards in practice and addresses the relationship between education and industry-defined skill standards. Contains 130 references. (YLB)

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SKILL STANDARDS: CONCEPTS AND PRACTICES IN STATE AND LOCAL EDUCATION

A Synthesis of Literature and Alternative Conceptual Frameworks

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SKILL STANDARDS: CONCEPTS AND PRACTICES IN STATE AND LOCAL EDUCATION

A Synthesis of Literature and Alternative Conceptual Frameworks

May, 1996

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INTRODUCTION

Concerns over the productivity of the American work force have led policymakers to embrace skill standards as a promising educational reform and work force development strategy. As technological advances and international competition combine to alter the traditional marketplace, employers are increasingly seeking individuals who can adapt to changing workplace conditions. Offering a common lexicon for structuring curriculum and training programs, skill standards have been proposed as a means of increasing linkages between what is taught at school and needed in the workplace. To help achieve such linkages, federal and state public officials have been working with representatives from the private and public sectors to identify the core skills required for success in a variety of industry and occupational fields.

During recent years, federal efforts to promote a national skill standard system have focused on providing fiscal resources to drive system development. Several national initiatives, such as the *Goals 2000: Education America Act*, provide support to assist all students in meeting high academic and occupational skill standards. Specifically, the National Skill Standards Board, organized as part of the Goals 2000 legislation, has initiated efforts to identify industries and occupations that will help develop a nationally recognized standard system. Moreover, the *School-to-Work Opportunities Act* complements Goals 2000 reform efforts by encouraging educators to develop strategies to help all students achieve high standards in academic and occupational curricula. Also underway are a variety of state and privately funded efforts to develop industry and academic skill standards.

To develop a better understanding of how standards and certification programs might be structured for a national system, in 1992 the U.S. Departments of Education and Labor awarded 22 grants to technical committees made up of representatives from business, labor, and education from a number of industry and occupational areas (Chart 1). Intended to define the skill needs of entry-level workers within participating industries, standard committees are working to identify a set of voluntary national skills that employers and educators can use when developing curriculum and applied learning programs. Although semantics sometimes confuse the issue, developers have tended to define "skill standards" in terms of the knowledge and skills that an individual must acquire to succeed in a particular workplace or job. In some cases, committees have also attempted to develop performance standards that outline the level of skill competency that an individual must attain.

CHART 1

NATIONAL SKILL STANDARDS PROJECTS

- Advanced high performance manufacturing
- Agricultural biotechnology
- Air conditioning, heating, and refrigeration
- Automobile, auto body, and medium/heavy truck
- Bioscience
- Chemical process industries
- Computer-aided drafting and design
- Electrical construction
- Electronics
- Grocery
- Hazardous materials management technology
- Health care
- Heavy highway/construction and environmental remediation
- Hospitality and tourism
- Human services
- Industrial laundry
- Metalworking
- Photonics
- Printing
- Retail
- Welding

SOURCE: Rahn, Mikala. (1994). *Profiles of the National Industry Skills Standards Projects.* Berkeley: National Center for Research in Vocational Education.

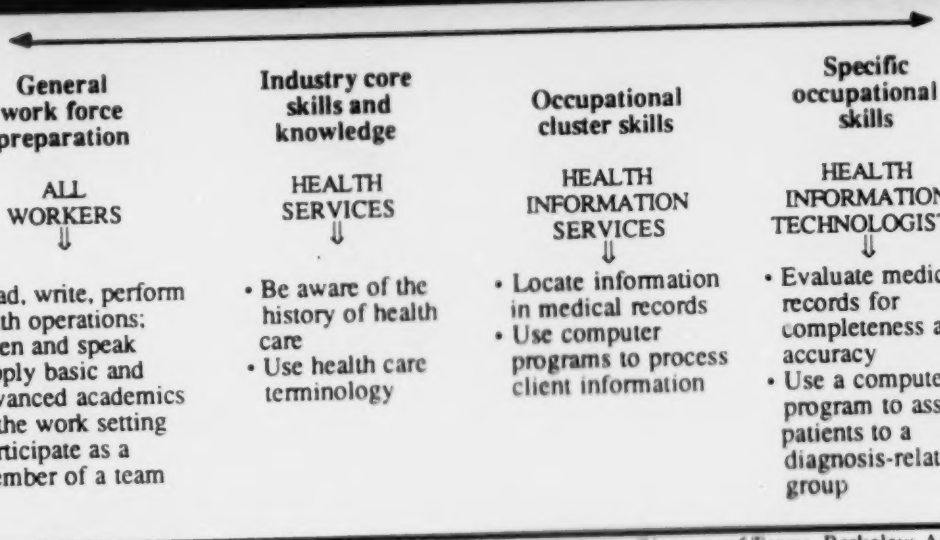
Early results from these and other skill standard projects suggest that developers are using a variety of techniques to identify standard frameworks. While some have taken a traditional task analysis approach to specify detailed lists of abilities and skills that characterize specific occupations, others have sought to define "knowledge and skills" more generically. Moreover, at least one has pursued a "scenario" organization that contextualizes standards in complex situations requiring an integrated application of academic knowledge and industry-specific skills.

Generalizing a Framework

A synthesis of national, state, and private-sector projects suggests a continuum of approaches that may be used to draft standards, with the degree of skill specificity ranging across a number of dimensions. At their most general level, standards may be used to promote the mastery of broad knowledge and skills. Moreover, basic work force preparation may be offered within traditional subject area disciplines or broad career areas that provide contextualized opportunities for learning (Chart 2). Alternatively, skills may be defined in more narrow industry- or occupationally specific terms. Occupational cluster and specific occupational skills describe a progressively more focused set of standards that a worker might need to master in order to find a job within a group of related occupations or a specific occupational field. Although skills may be transferable across industry areas, standards are designed around a specific workplace task or group of tasks that employees routinely perform.

CHART 2

SKILL STANDARD CONTINUUM
EXAMPLES FROM THE HEALTH INDUSTRY


General work force preparation
ALL WORKERS
• Read, write, perform math operations; listen and speak
• Apply basic and advanced academics in the work setting
• Participate as a member of a team
Industry core skills and knowledge
HEALTH SERVICES
• Be aware of the history of health care
• Use health care terminology
Occupational cluster skills
HEALTH INFORMATION SERVICES
• Locate information in medical records
• Use computer programs to process client information
Specific occupational skills
HEALTH INFORMATION TECHNOLOGISTS
• Evaluate medical records for completeness and accuracy
• Use a computer program to assign patients to a diagnosis-related group

SOURCE: MPR Associates, Inc. (1995). *School-to-Work Opportunities Glossary of Terms*. Berkeley: Author.

While skill standard development within the typology has similar objectives—to prepare youth for continued educational growth and economic success—the goals and techniques to reach this objective differ. To illustrate how each of the above models might actually work, this research synthesis reviews how employers, educators, and professional and labor organizations have adapted general work readiness, industry core, occupational cluster, and specific occupational skills to design and implement a skill standard system.

The primary goal of this research synthesis is to describe and analyze a continuum of alternatives that have been proposed for conceptualizing skill standards. Organizing these alternative conceptions of skill standards and clarifying the types of skills required for a changing marketplace is a first step toward defining a framework that will support nationwide system-building efforts. A secondary objective is to lay a foundation for a subsequent research agenda that will identify the types of frameworks and implementation models that educators will find most useful when translating skill standards into classroom curricula. Given that lasting success in the labor force will increasingly depend on mastery of a broad range of knowledge and skills, this synthesis also pays special attention to the relationship between industry and academic skill standard projects. Finally, the ways in which "high performance" work organizations influence skill standard development is also considered.

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GENERAL WORK FORCE READINESS SKILLS

International development and technological advances have redefined the structure of work in America. Unable to survive in a high volume production environment, many U.S. firms are now becoming "high performance" work organizations. These firms are distinguished by a commitment to excellence in which product quality and customer satisfaction drive the delivery of customized goods in a timely, efficient manner.[1] In addition, high performance firms cut costs by eliminating middle-level management and transferring authority to front-line workers. Reorganizing the firm in this manner requires workers with fundamental skills that enable them to assume responsibility for plant operations.

Concerns over declining test scores and the emergence of "high performance work organizations" led the Commission on Skills in the American Work Force (1990), in their influential report *America's Choice: High Skills or Low Wages*, to propose recasting the nation's education and training system. Intending to outfit all individuals with the basic labor market skills required for workplace success, the Commission recommended establishing a set of educational standards benchmarked to world-class levels. As part of its plan, all students would master core academic and work readiness skills before entering the work force or pursuing postsecondary education or training. Since the release of its report, a number of national and state organizations have responded to the Commission's call for action.

Most standard developers recognize the need to identify a core set of general work readiness skills that include both academic and employability skills. *Academic skills* encompass a wide range of subject area knowledge that is often organized into specific discipline areas, such as mathematics or English. It has been suggested that academic skills may serve as a foundation for teaching more general employability skills, as well as a basis for preparing all youth for entering the work force. Those who have developed standards in this area often use the terms "academic," "content," and "curriculum" interchangeably to describe their work. *Employability skills* describe a broad set of abilities that all students should master before entering the work

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[1]The emerging high performance workplace has been discussed at length by a number of authors. See for example, R. Marshall. (1995). "Key Elements of High Performance Work Systems." In Tucker, M. (1995). *On Occupational Clusters: Early Thoughts on Organizing the Work of the National Skill Standards Board*. New York: National Center on Education and the Economy; Bailey, T. (1990). *Economic Change, Organizational Innovation, and Escalating Skill Requirements*, a paper prepared for the conference on Changing Occupational Skill Requirements: Gathering and Assessing the Evidence; Carnevale, A.P., Gainer, L.J., and Meltzer, A.S. (1988). *Workplace Basics: The Skills Employers Want*. Alexandria, Virginia: American Society for Training and Development.

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force. These skills include the capacity to work independently and as a member of a team, to carry out personal and social communications, and to demonstrate a grasp of technology and workplace issues. Standard development efforts in the area of employability or work readiness skills have often been called "basic skill" standards.

The following section reviews private- and public-sector efforts to identify and draft academic and employability skill standards. A key issue within the section, as well as a theme running throughout the entire report, is the relationship between industry and academic skill standards. The requirements of high performance work organizations on skill standard development and implementation are also considered.

Academic Standards

Academic standards are intended to encourage student mastery of specific knowledge and skills. The initial drive for academic standards was spurred by the release of the National Commission on Excellence in Education's influential report *A Nation At Risk* (1983). Painting a bleak picture of the American educational system, the Commission warned that America's position as a world leader was jeopardized by its inability to prepare youth for an increasingly competitive global marketplace. Moreover, the Commission suggested that the traditional curriculum of American high schools was weak and unchallenging, and recommended not only increasing state and local high school graduation requirements but also adopting more rigorous, measurable academic standards.

Support for educational standards was formalized at the President's Education Summit in 1989, when the President and the nation's governors agreed to set national goals to promote academic achievement. Unfortunately, measuring student progress toward meeting these goals was complicated by the absence of some form of objective standard or assessment system (Ravitch 1995). To remedy this situation, in 1991 and 1992, the U.S. Department of Education began funding representative groups of teachers and scholars to develop national academic standards in science, history, the arts, civics, geography, foreign languages, and English. Much of this initial work was funded through foundation grants to professional organizations.

Funding of the national academic standards projects signaled a departure from the traditional approach to educational reform. During the 1980s, educational legislation emphasized what Marshall and Tucker (1992) characterize as "design standards"—that is, standards stressing measurement of educational inputs (e.g., minimum attendance, classroom seat hours, and

graduation requirements) over student outcomes. However, standard setting in academic subjects signaled a focus on student performance mastery, by specifying what students should know and be able to demonstrate in order to graduate. Continued support for skill standards is provided by the *Goals 2000: Educate America Act*, which calls for ". . . the development and adoption of a voluntary national system of skill standards and certification." However, with the demise of the National Education Standards and Improvement Council, efforts to review standards developed by professional organizations, states, and localities will require a new mandate.

Academic Standards Projects

Ground-breaking efforts by the National Council of Teachers of Mathematics (NCTM) offered evidence that a viable set of national standards could be developed. In 1989, the NCTM released its landmark report *Curriculum and Evaluation Standards for School Mathematics*. Intended to establish a framework for guiding mathematics instruction, the NCTM report offered a vision of what mathematics curricula could provide in terms of content, priority, and emphasis (NCTM 1989). In particular, the report outlined a cogent set of curriculum standards for grades K–4, 5–8 and 9–12, as well as a general set of evaluation standards, and was quickly embraced by mathematics teachers nationwide. Within 3 years of publication, the impact of the NCTM standards could be seen in nearly every aspect of mathematics instruction (Ravitch 1995). Due to their widespread popularity and acceptance, the math skill standards were held up as a model for developing standards in other disciplines.

To date, national standards have been developed in mathematics, history, health, geography, physical education, civics, social studies, science, English, the arts, and foreign languages. Like the NCTM standards, almost all projects concentrate their standard-setting efforts on the elementary, middle, and high school levels, focus on identifying essential subject area knowledge and skills, and aspire to serve as agents of curricular reform.

While all academic standards projects address work force readiness skills at some level, in most cases, these references are indirectly incorporated into the academic standards used to measure skill development. For example, the National Standards for Civics and Government require students to interpret and explain knowledge in the context of the academic subject, while the national math standards ask students to learn how to think and solve problems as a mathematician (Chart 3). It may be no coincidence that certain general work force readiness skills—such as the capacity to communicate and solve problems—overlap with how academic skills are measured. The ability to assess a situation, formulate solutions, and select and

implement a response is a central component of success in life, and individuals might be expected to face a stream of such events, whether they are in the educational or work setting.

CHART 3

NATIONAL ACADEMIC STANDARDS

National Standards for Civics and Government

Objective: *How American constitutional government has shaped the character of American society. Students should be able to explain the extent to which Americans have internalized the values and principles of the Constitution and attempted to make its ideals realities.*

To achieve this standard, students should be able to—

- explain ways in which belief in limited government has influenced American society;
- explain ways in which the Constitution has encouraged Americans to engage in commercial and other productive activities;
- explain how major features of the Constitution, such as federalism and the Bill of Rights, have helped shape American society;
- describe, giving historical and contemporary examples, how Americans have attempted to make the values and principles of the Constitution a reality.

Curriculum and Evaluation Standards for Mathematics

Objective: *Mathematics as communication*

In grades 9–12, the mathematics curriculum should include the continued development of language and symbolism to communicate mathematical ideas so that all students can—

- reflect upon and clarify their thinking about mathematical ideas and relationships;
- formulate mathematical definitions and express generalizations discovered through investigations;
- express mathematical ideas orally and in writing;
- read written presentations of mathematics with understanding;
- ask clarifying and extending questions related to math problems they have read or heard about;
- appreciate the economy, power, and elegance of mathematical notation and its role in the development of mathematical ideas.

SOURCE: Center for Civic Education. (1994). *National Standards for Civics and Government.* Calabasas, CA: Author. National Council of Teachers of Mathematics. (1989). *Curriculum and Evaluation Standards for School Mathematics.* Reston, VA: Author.

Of the many academic skill standards projects, The National Council for Social Studies is one of the few organizations to specifically describe how thinking, reasoning, communications, and teamwork skills can be applied to help students acquire and organize information. A separate section in the back of their report, entitled *Essential Skills for Social Studies*, describes the level and type of cognitive skills that should be included in instructional efforts. These skills have been broken into three areas: 1) Acquiring Information; 2) Organizing and Using Information; and 3) Interpersonal Relationships and Social Participation (Chart 4). A number of specific skills and standards have been identified within each of these three broad categories.

CHART 4

CURRICULAR STANDARDS FOR SOCIAL STUDIES

Skill Areas

Acquiring Information	Organizing and Using Information	Interpersonal Relationships and Social Participation
Reading skills	Thinking skills	*Personal skills*
Study skills	Decision-making skills	Group interaction skills
Reference and information-search skills	Metacognitive skills	Social and political participation skills
Technical skills unique to electronic devices		

Standards: Personal Skills

- Express personal convictions
- Communicate own beliefs, feelings, and convictions
- Adjust own behavior to fit the dynamics of various groups and situations
- Recognize the mutual relationships between human beings in satisfying one another's needs

SOURCE: National Council for the Social Studies. (1994). *Expectations of Excellence: Curriculum Standards for Social Studies*. Washington, DC: Author.

Since initially there were few efforts to coordinate the individual academic projects, it is not surprising that the format and substance of standards vary widely. Some projects, such as civics, emphasize content standards only, while others, such as science, include teaching and program standards in addition to subject area knowledge. Moreover, some projects, such as mathematics, offer diversified standards that include extended topics for students intent on pursuing college training. It appears that each project is also proceeding with developing standards independent of other efforts; that is, there is little if any attempt to integrate standards in specific disciplines with other subject areas. Standards are also written with different

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audiences in mind. Some of the standards, such as mathematics, provide detailed instructions to assist teachers in developing curriculum, while others, such as science standards, address several audiences at once, including teachers, policymakers, and higher education faculty.

To date, academic standards should be viewed as the "best thinking" in the field. Standard drafting committees are often composed of the most prominent academic leaders in the field, and include instructors from the elementary, secondary, and postsecondary levels, as well as members of professional organizations and the community. Since representatives within a particular subject area worked to identify standards, some amount of conflict was inevitable. For example, references to particular pieces of literature inhibited the development of skill standards for English, which are only now being released. What was perhaps most unexpected was the storm of controversy that erupted following the public release of some standards. A number of constituent groups have challenged the content of the civics and history standards; therefore, it is now questionable whether these standards will ever be fully acceptable even following revision. Subjects that address less controversial political and ethical issues (e.g., mathematics), have faced less external opposition, however. This may bode well for the development of industry or occupationally focused skill standards where content is less subject to personal interpretation.

State Models

Nearly all states have engaged in some form of standard development activity. According to a recent *Education Week* poll, some 28 states presently report standard-drafting efforts (*Education Week*, April 12, 1995). Since states cite various reasons for developing standards, the result is that reform activities often lead in different directions. States also vary in the amount of resources they have allocated for standard development. For instance, some states have developed standards for many subjects, while others are limiting their efforts to two or three academic disciplines.

Throughout the 1980s, California has developed a reputation for creating rigorous, high quality academic standards. Currently, the state has adopted academic standards (called "curriculum frameworks") in English-language arts (Chart 5), as well as science, history-social science, mathematics, art, health, and physical science. Produced on a 7-year cycle by a committee under the direction of the Curriculum Development and Supplemental Materials Commission, each framework undergoes extensive field review and public comment before being adopted by the State Board of Education (Honig 1991). Frameworks are used statewide for a variety of purposes, including curriculum planning, the selection and evaluation of instructional

materials, the development of model curriculum standards, the development of instructional programs, and staff development. Additionally, California is one of 22 states that has adopted choosing textbooks on a statewide basis. Since California uses its frameworks to select textbooks, many publishers are in effect using the state's frameworks to set curriculum for textbooks released nationally.

CHART 5

CALIFORNIA ENGLISH-LANGUAGE ARTS FRAMEWORK

Objective: ***Establishing a Literature-Based Program***

A literature-based English-language arts curriculum provides students with three important approaches to discovering the meaning of human experience through the language of literature:

- An in-depth study of core literary works, those substantive readings that speak to important questions and values all of us in a community must address
- Reading of literature that extends the study of the core work, captures students' individual interests, and challenges them to explore new avenues on their own
- Recreational-motivational reading that is based on students' natural curiosity and that encourages them to read for pleasure.

Curriculum Standards

Establishing a Literature-Based Program:

Develop Ethical, Aesthetic, and Cultural Values
Standard 1: Students study the central works to develop ethical, aesthetic, and cultural values.

Confronting Major Social and Political Issues
Standard 2: Students confront the major social and political issues, thus acquiring a common body of knowledge embedded in literature.

Participating in an Extensive Reading Program
Standard 3: Students participate in an extensive reading program supported by a large library system, including classroom, school, and community libraries. Both core works, studied in depth by all students, and "good reads," selected by students from works included on the extending reading list, make up each student's reading program.

Selecting a Core of Literary Works for All Students
Standard 4: Personnel in school districts select a core of literary works for all students to encounter. Together, students study some works in depth, and they read some works on their own.

SOURCE: California Department of Education. (1987). *English Language Arts Framework*. Sacramento: Author; California Department of Education. (1990). *English-Language Arts Model Curriculum Standards, Grades Nine–Twelve*. Sacramento: Author.

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Like California, Oregon has drafted content standards to drive curricular development in six academic areas: English-language arts, math, science, social studies, second language, and the arts (Chart 6). While earlier drafts also included separate content standards for complex reasoning skills, such as critical thinking and problem solving, the state ran into difficulty when attempting to create assessment instruments. To circumvent this situation, the state has instead integrated related employability skills within specific content areas as a means of assessing academic standards. The expectation is that by threading basic and complex reasoning skills throughout the curriculum, standards can be used to assess academic subject matter, while addressing the development of general employability skills.

CHART 6

OREGON CONTENT STANDARDS

Content Areas

- English Language Arts
- *Mathematics*
- Science
- Social Sciences
- Second Language
- The Arts

Mathematics

Mathematics is a compact, carefully defined symbolic language that facilitates modeling, solving, and communicating problems from a wide variety of disciplines, including science and technology.

Standard 1: Numeracy and Estimation
Select and apply mathematical operations and number relationships in a variety of contexts

Standard 2: Measurement
Select and use units and tools of measurement

Standard 3: Statistics and Probability
Collect, organize, display, interpret, and analyze information and data

Standard 4: Algebraic Relationships
Represent, develop and describe generalizations through patterns, graphs, and functions

Standard 5: Geometry
Understand two- and three-dimensional reasoning skills, coordinates, and transformational geometry and the use of geometric models to solve problems

Standard 6: Mathematical Problem Solving
Design, implement, and communicate a variety of strategies to solve problems

SOURCE: Oregon Department of Education. (1995). *Oregon Academic Content Standards & Benchmarks.* Salem: Author.

Note how the state has embedded critical thinking skills into each of the standard areas. In particular, observe how standards require students to read, write, and interpret numbers; develop rules to solve problems; apply mathematical concepts; and design, implement, and communicate problem-solving strategies. In essence, Oregon has implicitly integrated general employability skills into basic academic content areas as a means of measuring students' mastery of specific subject-matter knowledge.

Although most academic standards efforts do not directly refer to "employability skills" by name, many have incorporated the workplace skills into academic standards. Since most projects use process-driven methods to teach academic skills, the same complex reasoning skills that promote work force success, such as thinking and problem solving, can also help engage the learner in the academic discipline. In fact, several of the groups developing national and state standards describe the need for students to use higher order thinking skills in order to master the academic discipline.

Employability Skills

Concerns over the changing skill demands of the American workplace have led policymakers to define skills that capture the essential attributes of high performance workplaces. Although a number of groups have attempted to draft employability skill standards, there has been remarkable overlap among the types of skills identified. Similarities may be traced, in part, to both a clear recognition of the types of abilities required for workplace success and efforts of the 1991 Secretary's Commission on Achieving Necessary Skills (SCANS). Focusing on the types of skills all youths must have in order to enter and succeed in the labor market, the SCANS project identified three foundation skills and five key competencies that now serve as a model for other groups. Like most attempts to define employability skills, the foundation skills begin with the basic academic skills that all students must master (see appendix 1 for SCANS standards).

National Organization

Recognizing that a number of groups have identified workplace readiness skills, the Council of Chief State School Officers (CCSSO) is attempting to map national- and state-identified standards into a "consensus framework" that captures the important conceptual features of different efforts. In distilling this single framework, the CCSSO has taken an important step toward identifying a core set of skills that might guide a national work readiness system (CCSSO July 1995). The objective of the CCSSO effort is to generalize a common set of

standards that states can link to their own academic curriculum frameworks as they begin to build their own employability standards and assessments.

Prototype employability assessments are presently being developed by the CCSSO, a first set of which focuses on teamwork skills. Intended to help teachers integrate employability skill standards into their instructional repertoire, teamwork standards are based on actual assessments used by employers in workplace settings. As shown in Chart 7, proposed standards focus on three core areas that may be generalized across any academic subject area.

CHART 7

SELECTED CCSSO TEAMWORK SKILLS AND STANDARDS

Teamwork Skills

1) **Interpersonal Skills:**

- Reinforces and supports others ideas—listens nonjudgmentally to other's ideas, and paraphrases or repeats others ideas to show understanding
- Nonverbally demonstrates warmth and openness—listens silently to other team members, and makes eye contact when appropriate

2) **Thinking/Problem-Solving Skills:**

- Sets goals—identifies primary goal and subgoals for accomplishing a task; monitors progress toward the goal
- Analyzes the problem and/or situation—collects information to help demonstrate the extent of a problem or opportunity
- Allocates resources—makes decisions about how to allocate resources to accomplish tasks/produce products or deliver services

3) **Personal Development:**

- Exhibits integrity—treats others on the team fairly and with respect
- Acts responsibly and dependably—completes tasks when they are due

SOURCE: Council of Chief State School Officers Workplace Readiness Assessment Consortium. (1995). *Assessing Teamwork Skills for Workplace Readiness Prototype Models.* Washington, DC: Council of Chief State School Officers.

Researchers from the National Center for Research on Evaluation, Standards, and Student Testing (CRESST) are also developing prototype assessment tools for measuring negotiating, teamwork, and problem-solving skills identified in the SCANS framework. Studies by CRESST researchers suggest that assessments may readily generalize across a number of theoretical frameworks advanced by state and other national organizations (Baker and O'Neil 1992).

The New Standards Project, a nonprofit organization attempting to implement the recommendations in *America's Choice: High Skills or Low Wages!*, has also drafted standards that will assess employability skills. This project is a partnership of 17 states and several school districts working to create an assessment system to measure students' progress toward meeting core academic standards. Performance standards describe what students should know and the ways that they should demonstrate their knowledge and skills. As part of their Applied Learning performance standards; the New Standards group has identified five specific skills that have been linked to success in the high performance workplace, as shown in Chart 8.

CHART 8

APPLIED LEARNING

1) **Problem Solving**
Apply problem-solving strategies in purposeful ways, both in situations where the problem and the desired outcomes are clearly evident and in situations where they are not

2) **Communication Tools and Techniques**
Communicate information and ideas in ways that are appropriate to the purpose and audience though spoken, written, and graphic means of expression

3) **Information Technology Tools and Techniques**
Use information technology to collect, analyze, organize, and present information

4) **Learning and Self-Management Tools and Techniques**
Manage and direct one's own learning

5) **Tools and Techniques for Working With Others**
The capacity to work with others to achieve a shared goal and contribute to on-the-job learning and to respond effectively to the needs of a client

SOURCE: New Standards. (1995). *Performance Standards: Volume 3 High School.* Consultation Draft. Washington, DC: Author.

Private Sector

Private-sector employers are typically concerned with describing the essential skills, knowledge, and abilities required for occupations within their specific industry. One example of how an industry group has approached developing general work readiness skills comes from the Banking Skill Standards project in California, a joint venture between the California Business Roundtable and the California Department of Education. In outlining skill standards for career entry positions in the banking industry, project staff identified a set of employability skills that closely resemble the foundation skills and competencies outlined in SCANS (Chart 9).

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CHART 9

PERFORMANCE STANDARD

Skills	Standards	Performance Standard
Personal Work Ethic	Be ethical	• Relate to others with honesty and perform with integrity • Bring ethical conflicts to attention of appropriate person
	Take initiative	• Seek opportunities for problem solving
	Demonstrate reliability	• Follow through on task assigned • Keep a record of punctuality and attendance for a 12-month period
	Remain flexible	• Handle multiple tasks and adjust to changes in work environment
	Be professional	• Maintain positive demeanor; use appropriate language • Seek opportunities for self-improvement and team success
Thinking Skills	Solve problems	• Research information, identify options, reach workable solutions • Refer problems to supervisor as appropriate
	Organize and prioritize	• Prioritize work flows, locate and use resources, manage tasks
	Work efficiently	• Accomplish tasks, meet deadlines, exceed productivity standards
	Attend to detail	• Accomplish all work assignments accurately and efficiently • Follow directions, completes bank forms, completes information
Banking Industry Knowledge	Understand regulations	• Adhere to banking laws, regulations, policies, and procedures
	Maintain security	• Describe the importance and follow company regulations • Maintain confidentiality

SOURCE: BW Associates. (1994). *Banking Skill Standards for Career-Entry Positions in California.* Sacramento: California Department of Education.

What is interesting, and may have implications for other skill standard efforts, is how the banking standards group tailored standard identification to the banking industry. Given the responsibility and attention to detail that characterize the industry, it is not surprising that the group placed particular emphasis on personal work ethics and thinking skills. Moreover, the group was able to introduce banking into the work organization skills section, and in so doing, created a set of industry-specific general work readiness skills.

Curriculum and Testing Companies

One of the more systematic attempts to link general employability skills to specific occupational areas has been undertaken by American College Testing (ACT) through its Work Keys system. Using a computerized job profiling system, subject-matter experts (i.e., job incumbents and/or their supervisors) are able to identify the tasks, select the skills, and earmark the level required for effective performance in any job. An assessment component enables individuals to demonstrate their skill competency through performance-based assessments. Scores are compared against predetermined levels of proficiency established through the job profiling component to assist employers and applicants in identifying areas in which they may require supplemental training.

The ACT group has identified five academic and five people/personal skills that are essential to productivity and keeping pace with workplace change:

Academic Skills	People/Personal Skills
Reading	Organizational effectiveness/Leadership
Computation	Interpersonal/Negotiation/Teamwork
Writing	Motivation and self-development
Problem solving/Critical reasoning	Listening and oral communication
Scientific reasoning	Ability to learn

Work Keys job profiling is intended to help employers identify the skill levels that are related to effective performance in specific jobs, and to help individuals assess whether their skills are sufficient for employment in specific occupations or career paths.

Other curriculum and testing companies also offer an array of products for identifying work readiness skill standards. In many cases, these products were designed and offered in the context of vocational education, which means that a relatively specific set of skill standards have been developed. Even so, a wide variety of assessment and curricular packages exist for measuring employability skills (Tuma and Matloff 1993). For example, the Agency for Instructional Technology (AIT) markets a series of curriculum and assessment modules that focus on self-management, teamwork, and problem-solving skills. Skill standards are then assessed based on a written test and observation of student and group dynamics.

State Efforts

Seven states (Kentucky, Maine, Massachusetts, New York, Oregon, Vermont, and Washington) are currently developing performance standard systems modeled after the Certificate of Initial Mastery described in the *America's Choice* report. Standard development stresses academic and employability skills identified as necessary for high performance workplaces. Although all states are making progress, Oregon is perhaps the farthest along in enacting systemic reform: the state has defined standards and is developing assessments that will measure students' skill mastery in grades 3, 5, 8 and 10. Separate assessments and skills that will be used to award Certificates of Advanced Mastery are also being drafted.

Although few states plan to design separate courses or administer separate tests to measure employability skills, a number of states, including Maryland and Michigan, have explicitly defined career and employability skill standards. Here the goal is to help educators understand the types of skills that should be taught in all subjects. Serving as a separate set of learning goals, these employability skills are intended to

> . . . be used as a template to guide curriculum development in any course and a quality control template in required academic subjects, pulling them toward better learning experiences, high quality thinking, more effective communication, and use of technology and learning experiences that teach students to work and learn together (Maryland State Department of Education 1995).

On the other hand, the state of Michigan has identified 10 content standards that constitute the basic academic and workplace competencies that assist an individual in finding, keeping, and advancing on the job. These standards are to be assessed in a student employability portfolio that is completed throughout a student's high school career. Standards have been developed in the following three areas and 12 subareas:

Academic	**Personal Management**	**Teamwork**
Communication	Responsibility	Communicating
Mathematics	Organization	Responsiveness
Science and technology	Flexibility and initiative	Contributing
Problem solving	Career development	Group membership

As an example, Chart 10 lists standards in the Personal Management standard area.

CHART 10
MICHIGAN EMPLOYABILITY SKILL STANDARDS

Academic: ***Problem solving***

- Recognizing and defining problems
- Determining the source of the problem
- Finding new and creative ways to solve the problem
- Selecting the best solutions among the alternatives
- Carrying out decisions and evaluating the results

Personal Management: *Responsibility*

- Having a good school/work attendance record
- Demonstrating self-control where minimum directions and supervision are given
- Planning for a decision that significantly affects your life plans (e.g., choosing a college/career path)
- Meeting school/work deadline

Teamwork: *Responsiveness*

- Recognizing differences of gender, age, and culture in team activities
- Adding to another member's idea to improve it
- Accepting others' cultural traditions
- Seeking out understanding of people with different backgrounds

SOURCE: Michigan Department of Education. (1995). *Career and Employability Skills Content Standards and Benchmarks*. Lansing: Author.

Nearly all standard drafting projects have identified generic skills that enable workers to adapt to changing organization in industry and the workplace. These skills typically describe broad basic academic and life skills that help a person function in society, as well as complex reasoning skills and attributes that require students to define and solve problems, evaluate problems, and work with others (Stasz, McArthur, Lewis and Ramsey 1990). While the substance and language of specific skills differ among groups, standard-drafting efforts by national, state, and private-sector groups show remarkable overlap, as shown in Chart 11.

CHART II

SELECTED EMPLOYABILITY SKILLS

	SCANS	ASTD	CCSSO	Maryland
Date	**1991**	**1990**	**1995**	**1995**
Group	National Commission	Private Sector	State Educators	State
BASIC/ENABLING SKILLS				
Basic Skills	Reading, writing, math, listening, and speaking abilities	Reading, writing, computation, speaking, and listening	Math, communications, science and technology, social sciences, art, health, and physical education	Plan, participate within, monitor, and evaluate communication experiences
COMPLEX REASONING SKILLS AND DISPOSITIONS				
Cognitive Skills	Creative thinking, decision making, problem solving, and reasoning skills	Creative thinking, problem solving, knowing how to learn, and adaptability	Define and analyze problems; evaluate information; creativity; and make decisions	Think creatively, critically, and strategically; make decisions and solve problems
Personal Skills	Responsibility, self-esteem, social and self-management, and integrity/honesty	Personal management, self-esteem, motivation and goal-setting, and career development	Responsibility; integrity; safety; promptness; self-motivation; self-management; and career planning and development	Plan, monitor, and evaluate learning experiences
Social Skills	Team member, leader; negotiates, and works with others	Interpersonal skills, work in teams, and negotiate with others	Leadership; build consensus; conflict resolution; teamwork; and respect others	Work effectively with others and participate responsibly in a variety of situations
Work Organization Skills	Information use; allocate human and fiscal resources; understand work structure; and monitor and correct performance	Understand organizational culture and share information	Understand work flows through the system; gather, organize, interpret, and share information; and participate in the work organization	
Technology	Understand technology; select, apply, and maintain and troubleshoot equipment		Learn current and emerging technologies; solve technology problems; and evaluate and improve technologies	Understand, apply, and evaluate technologies

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While there is widespread recognition among employers of the importance of basic skills, Bailey and Merritt (1995) note a tendency among standard-setting groups to simply reapply the traditional task identification approach to academic domain and cognitive skill areas. Even though identifying these skills can offer workers more autonomy, adding new elements to existing task lists merely perpetuates the traditional conceptualization of work. Bailey and Merritt state that it is how employability skills are packaged and evaluated that colors an occupation's perception and status, and suggest that past efforts to identify skill holdings are but a first step in formulating and building a comprehensive skill standard system.

Although defining general work readiness skills appears relatively straightforward, drafting actual standards and assessment instruments may be somewhat more problematic. To begin, it is not clear that a complex reasoning skill, such as critical thinking or problem solving, can be taught in abstraction (Resnick 1994). While one can imagine applying problem solving within the context of a specific academic or industry area, it is less certain that one can extract and measure essential employability skills from content areas. A number of standard-setting groups are presently wrestling with this question.

Integrating Academic and Employability Standards

Nationwide efforts to develop employability and academic skill standards are proceeding along parallel tracks. Recognizing the importance of developing complex reasoning skills, both state content and national academic standards projects are attempting to integrate the teaching of general work force readiness skills into their drafting efforts. While a number of groups, including the CCSSO and New Standards are attempting to draft performance assessments that can measure general work force readiness skills, most groups are attempting to contextualize these skills within specific content area knowledge.

It is not clear that by simply integrating academic standards with employability skills transferable work force skills will be developed. While it is promising that academic standards projects are working to develop "high performance" skills that employers desire, if skill development is domain specific, then the teaching of complex reasoning skills will not guarantee that students graduate with the basic competencies for workplace success. Clearly, additional research will be required before this question is answered.

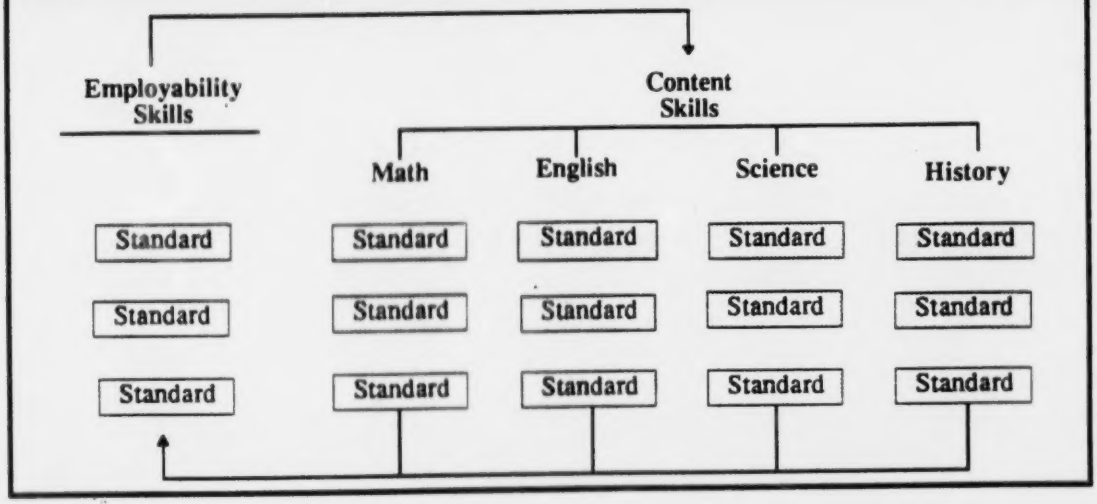
So far, Marc Tucker may have come closest to describing a system to link national academic, state content, and employability skill standards. Under his description of core standards, Tucker proposes creating

> . . . [a] universal standard to be met by anyone wishing to work in firms employing high performance work organizations. It would include high academic standards in the core subjects in the secondary school curriculum and the standards related to the generic work skills required for success in such organizations. . . .

Designing such a system may require integrating broad work readiness skills already identified at the national level with academic standards within discipline areas. This may be less complicated than one might imagine because most academic standards projects have contextualized the teaching of employability skills within their discipline (Chart 12). As illustrated earlier, math standards are constructed so that students have to solve problems, communicate, and reason mathematically in order to master subject area knowledge. This approach integrates core cognitive skills into the discipline to encourage students to acquire domain-specific skills. Students are also asked to apply complex reasoning skills to develop academic competencies in other projects. For example, the science standards are constructed so that students must use critical and logical thinking skills to develop an understanding of scientific principles.

CHART 12

GENERAL WORK READINESS SKILLS



In addition to helping students learn specific subject area knowledge, complex reasoning skills can help students acquire skills that are linked to the high performance workplace. The issue that remains to be resolved is whether complex reasoning skills developed within academic discipline areas can transfer to the work setting. The following section will examine an industry framework that has been suggested for contextualizing the teaching of academic and employability skills in a meaningful way.

INDUSTRY SKILL STANDARDS

Industries can provide a useful framework for organizing an educational skill standard system. The breadth of occupational skills and knowledge found within most areas can offer a basis for contextualizing academic instruction, in part because broad industry applications need not be highly specialized or far removed from common knowledge or experience. Since academic and industry themes may be integrated without losing content, this approach to pedagogy can also provide a plausible pathway for all students to pursue education and training objectives without sacrificing academic rigor. This section reviews different proposals for developing an industry-based skill standard system for education, and describes some approaches that educators are presently using to implement comprehensive skill standard systems.

Industry Taxonomies

There are many ways to organize an educational skill standard system around industry. While there is no one accepted method, a review of the literature reveals that some effort has already been expended to identify potential industry-based skill standard frameworks. Proposed models for an American effort range from actual systems that are already in place to theoretical frameworks that might be used to conceptualize an industry-based system.

Sweden is one of the few countries to systematically adopt industries as an organizing framework for education. Between 1991 and 1994, the country reorganized its upper secondary vocational and technical system around 14 broad career pathways. Where before students were forced to select from among 300 occupationally specific vocational programs, the new system now requires students pursuing vocational studies to select from a broad industry field (Bailey and Merritt 1995). This inductive approach to defining a system—starting with specific occupations and clustering to form broad industry areas—is similar to work that has been done in the United States to define economic areas of activity.

For many years, government and private entities in the United States have charted work force activity by constructing matrices that "crosswalk" similar industries and occupations. In these matrices, business establishments are defined as industries on the basis of their principle product or activity (determined by annual sales volume), and are then classified in accordance to Standard Industrial Classification (SIC) procedures (U.S. Bureau of the Census 1994). At its most aggregate level, the SIC is composed of ten industry divisions.

CHART 13

INDUSTRY CLASSIFICATION FRAMEWORKS

Sweden's 16 National Programs	U.S. SIC System	Illinois 12 Industry Subcouncils	O*NET's 12 Career Families	Washington's 16 Industry Taxonomy
• Land and animal husbandry • Foodstuffs	• Mining • Agriculture	• Agriculture and natural resources	• Agriculture, forestry, and natural resources	• Agriculture • Natural resources
• Industry	• Manufacturing	• Manufacturing	• Manufacturing	• Manufacturing
• Trade and administration		• Business and administrative services	• Business, marketing, and management	
• Construction	• Construction	• Construction	• Construction	• Built environment
• Transport technology	• Transportation	• Transportation	• Transportation	• Transportation
• Health care		• Health/social services	• Health	• Health
• Energy	• Public utilities	• Energy and utilities		• Energy
• Leisure hotel and restaurant trades		• Hospitality		• Hospitality
• Aesthetic • Handicrafts				• Arts/culture/ religion
	• Retail and wholesale trade	• Marketing/retail trade		• Retailing and wholesaling
	• Finance, insurance, and real estate	• Finance services		• Finance • Insurance
• Child care		• Educational services		• Education
	• Services	• Professional services	• Consumer and personal services	• Personal and business services
• Media	• Communication	• Communications	• Arts, media, and communications	• Communication
• Electricity		• Electronics	• Engineering/ science • Service technician occupations	
• Social sciences	• Public administration		• Community service	• Government
• Natural sciences				

The state of Illinois provides a good example of how a state-based industry classification system might be structured. The Illinois Occupational Skill Standards and Credentialing Council (IOSSCC), an appointed council of members from the business, industry, and labor communities, has three specific functions: to recognize and develop skill standards and credentialing systems; to market and promote the application of these systems in the private sector; and to work with state councils and agencies to promote the use of standards and

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credentials in the publicly funded and regulated work force development system (IOSSCC March 1995). As Chart 13 shows, Illinois has identified 14 industry areas that serve as a basis for its state standard system.

Two other proposals for defining industry-oriented skill standards include the Center for Occupational Research and Development's (CORD) integrated system for work force education and the Gnaedinger taxonomy. Using the term "career family" to designate related work areas, CORD has identified 11 industries that account for a large proportion of the American economy (CORD 1995). Similarly, John Gnaedinger, an engineer interested in work force preparation, has developed an industry taxonomy that divides the U.S. economy into 16 comprehensive industries. Because Gnaedinger was concerned with providing high school students with information about a wider range of career opportunities than those found in traditional vocational education programs, his vision includes organizing the curriculum of entire schools, or schools-within-schools, around broad industry classifications (Hoachlander 1994).

To obtain a manageable number of industry areas, organizations have in some cases aggregated large economic sectors that share common attributes. For example, all five standard-setting efforts recognize transportation as an industry sector that represents a substantial and cohesive piece of the economy. However, each of the subindustries that make up this area—maritime, rail, aviation, aerospace, and automotive—might just as well be called "industries" in their own right. Alternatively, business and administration is recognized as a separate industry area even though business functions are a central component of all industries. Although there is no one accepted way to identify industries, a number of secondary high schools nationwide presently use industry-oriented themes to contextualize academic instruction. In actual practice, educators have proven quite adept at developing academic curricula organized around a subset of an industry field.

To ensure that students obtain a broad foundation of knowledge, the 1990 Carl D. Perkins Vocational and Applied Technology Education Act stressed the need for programs to provide "strong experience in and understanding of all aspects of the industry the students are preparing to enter" (Public Law 524, 1984). Meant to broaden the scope of vocational education, the Act encourages schools and programs to incorporate a range of industry topics, including planning; management; finance; technical and production skills; underlying principles of technology; labor and community issues; and health, safety, and the environment. There is evidence to suggest that at least some states are developing their industry organizations with this counsel in mind. For example, as part of Illinois' Manufacturing industry standard-setting effort, the state

IOSSCC has designated subcouncils to develop skill standards in five manufacturing areas: Business Management; Distribution and Logistics; Production Planning and Organization; Marketing and Product Support; and Engineering and Research and Development.

Hoachlander (1994) adds to the "aspects" discussion when he posits that an industry-based curriculum needs to consider at least eight major influences on the functioning of an industry: structure and organization, history, technology, economics, human resources, government, health and safety, and environment. In addition to providing a more holistic approach to instruction, this approach can assist students in learning how different workers contribute to the functioning of an industry.

Standards in the Educational Setting

While systematic efforts to identify and organize major career areas are a necessary first step toward constructing a comprehensive skill standard system for education, it is worth noting that industry-based career clusters have a long history in education. For example, many vocational programs are typically organized around industry themes that provide a context for classroom instruction. In some cases, "industry" may offer an organizational framework at the state level as well. As part of its *Plans of Study* vocational program, Oklahoma offers 10th–12th grade students career preparation in 13 broad career areas, including: 1) Agriculture; 2) Business; 3) Construction, 4) Design, Communication, and Art; 5) Education; 6) Health; 7) Manufacturing; 8) Personal Service; 9) Repairers and Mechanics; 10) Sales and Marketing; 11) Science and Technical; 12) Social Science; and 13) Transportation. To introduce students to the range of occupations and postsecondary education/training opportunities available to them, students select studies in broad career pathways that serve as a unifying theme for subsequent coursework. For example, as part of their preparation in the Business Cluster, students learn about 38 potential careers in occupations ranging from accountant and computer system analyst to bank teller and receptionist.

As they are presently structured, vocational programs may fail to offer skill standards that link educational coursework with industry recognized standards. In many cases, schools tailor their students' course schedules to an industry theme by having students enroll in vocational courses that are related to the industry focus. When this occurs, the quality of instruction may hinge on local factors, including whether industry representatives are involved in curricular design, and on the depth of teacher subject-area knowledge.

CHART 14

WASHINGTON STATE MANUFACTURING COMPETENCIES AND PERFORMANCE OBJECTIVES

Core Competency Areas

- *Labor in Industry*
- Measurement
- Safety and Health
- Quality Assurance
- Print Interpretation
- Shop Skills
- Business Economics
- Resource Management
- Product and Process Control
- Group Dynamics and Communication

Labor in Industry: Seven Competency Areas

1) Understand labor's role in employee wages, benefits, and safety issues
2) Understand the role of labor unions in the economy
3) Know what a grievance is and how it may be pursued
4) Know what a shop steward does
5) Understand protections of collective bargaining and a negotiated contract
6) Understand the role of a union member
7) Possess knowledge of labor history and why labor unions were formed

Labor in Industry, Competency Area #1: Performance Objectives

1.1) Understand the different roles of labor and management
Given that both labor and management share many concerns and issues and that teamwork is necessary, the student will be able to identify the roles of labor and management and state the objectives of each.

1.2) List topics related to wages, benefits and safety issues
After studying worker issues regarding benefit, wages and safety issues, the student will be able to list five issues in each of the three areas:

Wages	Benefits	Working Conditions
Skill levels	Medical, dental	Safety and health
Experience levels	Pensions (retirement)	Tools, materials
Materials expertise	Life, accident insurance	Chemicals
Profit sharing	Sick leave	Hygiene
Over-time	Severance pay	Protective equipment
Part-time	Holidays	Training
COLA	Vacations	Shop stewards
Shift premiums	Personal-civic leaves	Breaks, lunch
	Family and bereavement	Worker's compensation

SOURCE: Washington State's Manufacturing Technology Advisory Group. (1994). *Manufacturing Technology Core Competencies and Performance Objectives.* Seattle: Author.

One of the more promising approaches to industry skill standards comes out of a Tech-Prep program in Washington State. As part of an effort to develop comprehensive programs in Manufacturing Technology, the state has convened a committee of representatives from industry, labor, education, state government, and community service organizations. To identify standards, the committee has focused on identifying skills in basic manufacturing education,

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rather than a specific industry or field (Chart 14). Then students who successfully complete the program are encouraged to continue their training by specializing in a particular manufacturing field.

Washington State began to draft its skill standards in the fall of 1992, when The Boeing Company surveyed its company managers to identify the basic entry-level manufacturing skills they desired in new employees. Eventually, survey efforts were expanded to include 55 firms and 16 Washington State Labor Council coordinators. Skills validation conducted in the fall of 1993 led to the identification of 10 categories of skill competencies, including 89 general competencies and 297 specific competencies. As a final effort, in the fall of 1994, a training consultant developed measurable performance objectives for each competency area.

A final document has been distributed to high schools and community and technical college educators to assist curriculum writers in identifying core competencies and related performance objectives that industry and labor expect from new labor market entrants. As a result of the positive feedback from this effort, the state has since organized similar groups to develop curricula in the electronics and machining industries.

Not all Tech-Prep programs offer curriculum as broadly structured as that in Washington State. Although program articulation is at the heart of most Tech-Prep programs, development of curricular materials and skill standards often varies by location. In most secondary and postsecondary institutions, new Tech-Prep courses are limited to the integration of academics with specific occupational information and skills; in some cases, new textbooks, computer software, or equipment may also be introduced. In a survey of 390 local Tech-Prep coordinators, Debra Bragg found that developing advanced skills technical curriculum is one of the more difficult tasks that Tech-Prep planners face (Bragg 1994). In some cases, this may be due to an inability to develop partnerships with local business, industry, and labor constituencies. Even when these connections are made, initial business input may be limited to classroom visits by industry representatives and student site visits to firms.

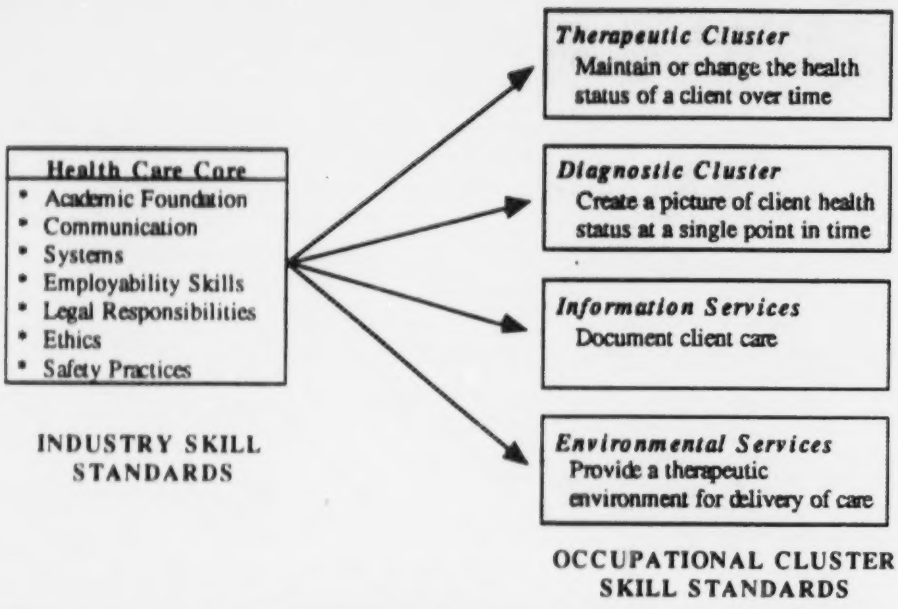
Industry Efforts

The National Health Care Skill Standards Project (NHCSSP) is one of the 22 national industry pilot projects funded by the U.S. Departments of Education and Labor. In an effort to generate what might be labeled "industrywide skills," the NHCSSP has taken a unique approach to defining the standards required for workplace success. Skill-standard drafting efforts have

focused on identifying a set of core industry content standards that would apply to most health care workers. Put another way, these standards focus on the knowledge and skills that all health care workers must demonstrate, rather than the level of achievement an individual must attain in a specific occupation. Building off these essential skills, NHCSSP project staff have also identified standards in four clusters of related occupations that span the career-entry and technical fields (Chart 15). In essence, health care skill standards are intended to prepare individuals for entry into health service professions, as well as horizontal and vertical movement within a specific career.

CHART 15

NATIONAL HEALTH SKILL STANDARDS



SOURCE: Far West Laboratory. (1995). *National Health Care Skill Standards*. San Francisco: Author.

In developing the standards, staff analyzed 60 occupations across 10 nationwide data sets that identify specific tasks health professionals perform as part of their duties. Standard development committees—composed of representatives from health services, labor, and education—then drafted standards using summaries of the task analyses and their own expertise. A 44-member standards committee reviewed the draft standards and made

recommendations before they were validated industrywide. Focus groups with health care workers held at 16 different health care delivery sites across the nation, along with input from more than 100 individuals who responded to a questionnaire, were used to validate the identified skills.

Industry core standards address a range of occupations and job functions. In stipulating the essential skills required for a career in the health care industry, project staff have attempted to incorporate general SCANS-like competencies as well as reference basic health-related knowledge and skills. As part of the Health Care Core Standards, individuals are expected to master broad competencies in eight standard areas, ranging from general academic and communication skills to more industry-specific applications (Chart 16).

CHART 16

HEALTH CARE CORE STANDARDS

Employability Skills

- Academic Foundation
- *Communication*
- Systems
- Employability Skills
- *Legal Responsibilities*
- Ethics
- Safety Practices
- Teamwork

Selected Standards

Communications: Health care workers will know the various methods of giving and obtaining information. They will communicate effectively, both orally and in writing.

- Assess others' ability to understand
- Adapt communication to individual needs, including paraphrasing or translating
- Ask for clarification when needed
- Be sensitive to multicultural and multilingual needs
- Use facility-specific guidelines and methods of sending and receiving information
- Access and use electronically produced information

Legal Responsibilities: Health care workers will understand the legal responsibilities, limitations, and the implications of their actions within the health care delivery setting. They will perform duties according to regulations, policies, laws, and legislated rights of clients.

- Be aware of malpractice and liability issues
- Maintain client confidentiality
- Operate within scope of practice
- Comply with legal requirements for documentation

SOURCE: Far West Laboratory. (1995). *National Health Care Skill Standards*. San Francisco: Author.

It is no accident that NHCSSP Standards specify such a broad range of basic skills. In developing standards, project staff recognized that the unique needs of the health care industry necessitated a generic set of standards that could be tailored by educators and practitioners to meet local needs. This is due, in part, to the diversity of occupations and skill requirements across health institutions, and to the changing nature of the health industry. With the advent of managed care and health maintenance organizations, the health sector has undergone radical changes; recent events suggest that the industry will continue to evolve, and in so doing, require new skills of entering workers. Thus, the industry-based approach to skill standards adopted by the NHCSSP represents a logical response to a set of economic pressures that are reshaping the health industry.

To summarize, while schools have successfully organized academic programs around industry themes, the question of skill specificity can be an issue in certain industry areas. Although it might be feasible to structure a program around a specific industry, such as industrial laundering or photonics, it is not clear that all industries offer the same opportunities for curricular development. A danger is that if standards become too narrow, it may become impossible to teach all aspects of an industry, or to contextualize necessary academic skills within an industry specialization. While "Automotive" might be an appropriate level at which to organize a school and set skill standards, the "Collision and Autobody Industry" may fail to provide the necessary context around which to organize an educational program. As such, attempts to define standards must take into account industry size and content-related issues; one suggested criteria has been to limit industry specifications to those accounting for at least 3 percent of the national employment or gross domestic product (Hoachlander 1994).

Since there is no one way to design a system to meet all needs, industry organizations will need to be flexible regardless of how they are defined. It is possible that educators might prefer to adopt a number of different industries around which to contextualize instruction in the earlier grades, and encourage students to wait until their junior or senior year to find a more focused field in which to specialize their studies. Alternatively, teachers might prefer to offer a selected number of industries around which all students might contextualize their studies. Regardless of the approach used, the type of standards that are drafted must be sufficiently general so as not to limit students' future educational and career plans. An alternative approach to achieving this goal might be to focus on the type of work individuals do within or across industry areas, rather than on the specific field in which the work is performed. The following section will address this issue in greater depth.

OCCUPATIONAL CLUSTERS

Most jobs have a unique set of skills, responsibilities, and performance tasks that differentiate them from work in other professions. Rather than specify requirements for each individual job in the economy, skill standard developers use cluster models to group related occupations that share a common skill base. At least in theory, individuals who have mastered the core competencies in a cluster area have the necessary background for a wide number of entry-level jobs in a particular occupational field. This section characterizes different frameworks that standard developers use to formulate and organize occupational cluster standards for education. Clusters from selected educational programs and national, state, and industry standards projects are used to illustrate issues related to standard development and implementation.

Skill standard developers often designate occupational clusters based on the types of tasks and outcomes associated with work. Jobs that require similar knowledge and skills are typically aggregated to form a single occupational cluster in which associated skill standards are identified and defined. *Cross-industry clusters* describe groups of occupations sharing related attributes, such as management or sales, that tend to span several or all industries. This means that the competencies of cross-industry skill standards may be independent of the context in which they are performed. *Industry-specific clusters* are used to describe groups of occupations that are typically associated with a specific industry or narrow sub-industry field, such as transportation or aviation. Here the substance and context of work is related across all jobs within an individual job cluster, and the skills across different clusters may vary widely. Regardless of the type of framework used to classify work, occupational clusters have long been used to define curriculum in secondary and postsecondary educational institutions, as well as to assist employers in training or retraining their existing work force.[2]

Cross-Industry Clusters

As Marc Tucker (1995) suggests, perhaps it is not the industry, so much as the set of skills people require that should drive standard definition. Indeed, as the U.S. Bureau of Labor Statistics struggles to reorganize its Standard Occupational Classification (SOC) system, skill comparability is a driving force for distinguishing occupations. A guiding principle for the SOC revision is that occupations be classified by the type of work performed, as well as the skills, education, training, licensing, and credentials related to the job (Bureau of Labor

[2]The term "career major" is often used interchangeably with occupational cluster to signify a group of related occupations in which students may concentrate.

Statistics 1995). This means that in some cases occupational designations may transcend traditional industry specifications.

As the SOC is presently structured, specific occupational areas are coded and classified based on the type of work, training, physical demands, and work conditions associated with specific jobs. At its highest level of aggregation, the SOC consists of six occupational clusters:

- Managerial and professional specialty
- Technical, sales, and administrative support
- Service occupations
- Precision, production, and craft and repair
- Operators, fabricators, and laborers
- Farming, forestry, and fishing

There is nothing sacred about this arrangement. The SOC is primarily intended as a reference tool for generating statistics on labor force characteristics, not for driving development of a skill standard system. One could just as easily disaggregate these six SOC clusters into smaller subclusters that would capture the elements of a number of related jobs within or across industries. This type of approach is essentially what Tucker suggests when encouraging the National Skill Standards Board to convene a group of industry experts to identify from 30 to 50 occupational clusters within a dozen or so industry sectors (Tucker 1995).

Educational Models

State educators often use a number of different terms when describing components of their skill standard systems. In the absence of a consistent national language, terms such as "occupational cluster," "career family" and "career major" often mean similar things in different states. Although most educators appear to be using the term "occupational cluster" to define broad industry areas (such as business/information systems), standard development within the cluster often focuses on different groupings of occupations. For example, where some states might use the Health Care cluster to describe all occupations related to the medical field, others might define the cluster as a subset of specific occupations, such as careers in the nursing field, in which a set of standards will be drafted.

State attempts to specify school-to-work occupational clusters have focused on identifying broad career areas that, when taken in their entirety, come close to but do not necessarily span the American economy. For example, as part of their efforts to design School-to-Work Opportunities programs, Massachusetts, New York, Oregon, and Wisconsin have identified a

number of career areas in which they are planning to develop standards and curriculum. Other states presently working to identify cluster areas include Maine (25 occupational clusters), Michigan (6–10 clusters), and Kentucky (8–15 clusters). As the system is presently conceptualized, participating students within each state would select from a range of occupational cluster areas that would serve as a basis for contextualizing academic and career instruction. While the timing of this selection may vary by state—in some cases, students will delay participation until their junior or senior year of high school—the intent is to develop programs that will enable students to earn certificates of competence that will document their skill holdings. Chart 17 details the types of occupational clusters/career majors of four states that have received federal School-to-Work Opportunities grants.

CHART 17
SCHOOL-TO-WORK OCCUPATIONAL CLUSTERS

Massachusetts	New York	Oregon	Wisconsin
	Arts and Humanities	Arts and Communication	
Commerce	Business/Information Systems	Business and Management	Finance Insurance
Healthy Bodies	Health Care	Health Services	Health Biotechnology
	Human and Public Services	Human Resources	
Making Tools, Toys, and Technology	Engineering/ Technologies	Industrial and Engineering Systems	Manufacturing/Metals Auto Technology
Our Natural Resources; From the Farm	Natural and Agricultural Sciences		
Built Environment			Drafting/Design
Communication			
Travel and Leisure			Hotel
Caring for our Community			
			Printing

SOURCE: U.S. Department of Education and Labor, March 1995.

To date, many states are still in the early stages of drafting standards. In some cases, states have yet to appoint representatives to panels that will be responsible for identifying skills, while in others preliminary work is just beginning. This delay may be due to the fact that many states are hesitant to invest in standard drafting activities until they receive some guidance from the National Skill Standards Board, which holds primary responsibility for laying the groundwork for a national system.

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One of the more systematic attempts to classify occupational clusters has been undertaken by the Center for Occupational Research and Design (CORD). As part of an attempt to develop an integrated system for work force education, CORD has identified 11 career families (roughly analogous to industry areas—see preceding section) that encompass a number of career themes. Career majors within each industry area illustrate the types of work an individual might find if pursuing related studies in the selected field. While the skills required for performing work within a particular career major are relatively similar, the types of occupations in which they may apply vary.

For example, CORD's Business, Marketing, and Management career family cluster consists of four industry-related career majors: 1) Management; 2) Finance, 3) Administrative Support, and 4) Marketing (Chart 18). Each of these majors includes a number of selected occupational fields. For example, students in the "Administrative Support" cluster would learn about clerical and office skills that would prepare them for work in a wide range of industries, such as the medical, legal, finance, or computer professions. Since standards have yet to be developed, it is not clear how educators would adapt the CORD taxonomy into their instructional activities.

CHART 18

CORD'S INTEGRATED SYSTEM FOR WORK FORCE EDUCATION

Family/Industry: Business, Marketing, and Management Occupations

Major/Cluster: Management	Finance	Administrative Support	Marketing
Occupation:			
Food service	Accounting	Stenography	Advertising
Lodging	Securities sales	Secretarial	Public relations
Public administration		Legal secretary	Sales and distribution
Medical services		Medical records	Real estate
Business administration		Clerical supervisor	Health coordinator
Personnel management		Bookkeeping	Fashion merchandising
		Office clerical	Sales
		Data entry	Food marketing
		Banking support	Purchasing
		Computer operation	Insurance
			Automobile sales

SOURCE: Center for Occupational Research and Development. (1995). *An Integrated System for Work Force Education*. Draft. Waco, Texas: Author.

Fairfax County, Virginia offers an interesting example of how educators have introduced career clusters into the academic curriculum. Beginning in the fall of 1996, Fairfax County schools will offer studies in four career cluster areas: 1) Communication and the Arts; 2) Engineering, Industrial, and Scientific Technology; 3) Health, Human, and Public Services; and 4) Business and Marketing (Lozada 1995). These broad clusters incorporate a large number of occupational areas. For instance, within the Engineering, Industrial, and Scientific Technology cluster, students may choose from elective coursework in more than 15 specific jobs in each of 10 professional fields, including environmental planner, plumber, mechanic, auto body technician, and aerospace engineer.

CHART 19

ENGINEERING, INDUSTRIAL, AND SCIENTIFIC TECHNOLOGY

This cluster provides three areas of study—engineering, mechanical, and construction. This course schedule example focuses on engineering

9th Grade	• Language Arts • PE and Health • World Studies I • Math (Algebra I or II)	• Science (Earth or Biology) • Intro to Engineering* • Engineering Drawing*
10th Grade	• Language Arts • PE and Health • Social Studies or Foreign Language	• Fine or Practical Arts • Math (Algebra II or Geometry) • Science (Biology or Chemistry) • Principles of Technology*
11th Grade	• Language Arts • U.S. History • Math or Science • Design and Technology*	• Desktop/Multimedia Presentation* • Information Systems* • Electronics*
12th Grade	• Language Arts • U.S. Government • Media Focus 2-D* • Computer Graphics*	• Discrete Mathematics* • Speech Communication* • Business Management*

*Denotes career cluster elective

SOURCE: Lozada, M. and S. Hindash. (1995). "A Model Reform." Vocational Education Journal. 70 (8).

Educational clusters can provide more than just focused career-oriented studies. The hypothetical schedule depicted in Chart 19 shows how a student in Fairfax County's proposed engineering cluster might schedule coursework that emphasizes a number of subjects,

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including technology, computers, design, communication, and management. Unfortunately, because academic subject areas are not integrated within career cluster studies in Fairfax County—a science class for a student in the Business and Marketing cluster would be the same as that for a student in Health, Human, and Public Services—this approach fails to integrate academic and career coursework.

Even overlooking this drawback, there is still an issue of whether these educational clusters, as they are currently defined, can offer students meaningful knowledge or industry skills. In most cases, skill standards in educational career cluster programs are not and cannot be validated against industry norms. This may occur because educational clusters include such a range of specific occupations that short of specifying skills for each cluster, it would be difficult to find a single association or group that could approve standards. For example, a student in the Health, Human, and Public Service career cluster in Fairfax County, would prepare for a range of jobs that include home health aide, physician, educator, police officer, caterer, and cosmetologist. Since there is presently little understanding or agreement about what constitutes a skill base for a career cluster area, offering students coursework in an occupational cluster may at best provide a context for integrating academic and career instruction. At worst, such action may simply result in the repackaging of vocational coursework under the guise of curriculum reform. One means of overcoming this problem is for educators to benchmark instruction to industry standards.

Industry-Specific Clusters

Aviation High School, located near two major airports in New York City, offers one of the better examples of how skill standards may be contextualized within an occupational cluster. Organized as a career magnet, the school focuses on graduating students with the skills to pursue postsecondary education as well as to enter careers in the transportation industry. All instruction is offered in a modern complex, which includes a hangar with 20 aircraft, shops that house aircraft engines, landing gear and propellers, and computer classrooms and science labs. Academic coursework is also contextualized around the transportation sector; for example, in history class, students study the history of flight. In addition to earning a high school diploma, students also have the option to qualify for a Federal Aviation Administration license in power plant maintenance, airframe maintenance, or both. Students wishing to return for supplemental coursework after graduation may also study for a Federal Communications Commission credential that will license them in Avionics (Mitchell, Russell, and Benson 1990).

To ensure that instruction is linked to federal aviation norms, roughly half the curriculum at Aviation High is tied to industry standards. Given the strict requirements for federal licensure, the school pays particular attention to ensure that classroom skill standards reflect contemporary industry norms. Representatives from all major airlines and the Grumman Corporation serve on the school's Aeronautics Advisory Board, which acts as a type of quality control system for the school. Board members work with teachers to ensure that subject matter and skills taught at Aviation High are the ones considered most important for aviation; in some cases, firms provide job-shadowing opportunities for aviation teachers so that they can keep pace with industry changes.

In addition to Aviation High, occupational cluster models can be found in a large number of career magnet and academy schools located throughout the United States. However, unlike Aviation High, most educational programs are not benchmarked to a set of recognized national skill standards. Aviation's success in introducing skill and performance standards may be traced to the fact that standards are set and administered nationally by the Federal Aviation Administration. In the absence of such systematic analyses of worker skill requirements within industry areas, educational skill standards, where they do exist, tend to reflect input from regional or local business representatives. While this assistance can help link educational instruction to industry needs, skill portability may be limited.

Private-sector efforts to develop occupational cluster standards have focused on lower level career-entry positions within specific industry areas. In the case of the national industry skill standards projects, this emphasis reflects instructions from the federal government, which require grantees to orient standard development toward nonbaccalaureate positions. However, targeting standard development at the entry level also makes sense from an economic perspective. Many industry representatives report difficulty in finding skilled workers for entry-level positions, and industry willingness to develop cluster skill standards reflects not only a recognition of the changing nature of the high performance workplace but also a desire to widely disseminate occupational skill requirements to educators and other training providers.

Perhaps the simplest way of organizing private-sector cluster standards is to envision a two-dimensional matrix, with industries as columns and occupational clusters as rows. The matrix proposed in Chart 20, based on the Bureau of Labor Statistics model, is intended to illustrate one possible approach to formulating an occupational cluster taxonomy. While a complete model might include all industries that span the U.S. economy, this discussion will confine itself to occupational clustering models proposed in the advanced manufacturing, banking,

bioscience, and electronics industries. As the matrix and discussion that follow show, these industries are attempting to develop skill standards that span a number of entry-level jobs.

CHART 20

INDUSTRY OCCUPATIONAL MATRIX

Occupational Clusters	Advanced Manufacturing	Banking	Bioscience	Electronics
Managerial and professional specialty				
Technical, sales, and administrative support				
Business and retail support				
Production and craft workers				
Operators and laborers				

*Shading indicates preliminary skill standard development

Mastery of standards within a specific cluster area is intended to signal that an individual possesses the necessary background skills to find work in any of a group of related jobs within a specified occupational field. Each of the four industry projects listed in Chart 20 have focused their standard drafting efforts within the Technical, Sales, and Administrative Support occupational cluster; in addition, the banking skill standard project has also attempted to identify cluster skills in the Business and Retail Support sector.

The National Coalition for Advanced Manufacturing skill standard project provides a good illustration of how an industry might develop global standards for all technicians entering the profession. To identify skill areas, the group conducted national surveys of managers and workers in high performance firms. Based on the results, project staff identified and validated 13 broad skill standards that span 234 academic, technical, health, business, and technology competencies. These skill areas and proposed standards are outlined in Chart 21.

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CHART 21

ADVANCED HIGH PERFORMANCE MANUFACTURING

Standard Areas

- *Communication and Teamwork*
- Math and Measurement
- Workplace Safety and Health
- Problem Solving
- *Quality Assurance*
- Blueprint Reading
- Manufacturing Fundamentals
- Business Planning and Operation
- *Computer Use*
- Product and Process Control
- Work Force Issues
- Workplace Skills
- Learning Skills

Selected Standards

Communication and Teamwork

1) Identify interpersonal characteristics of a team player
2) Demonstrate the characteristics of a team player
3) Contrast the role of a team with the role of a team player

Quality Assurance

1) Contrast quality manufacturing systems with other manufacturing systems
2) Identify influences of a quality system on specific manufacturing processes
3) Explain the effect of quality on profit

Computer Use

1) List possible computer applications in manufacturing processes
2) Identify possible effects of introducing computers into manufacturing processes
3) List various methods of tracking quantities

SOURCE: National Coalition for Advanced Manufacturing. (1995). *National Skill Standards for Advanced High Performance Manufacturing*. Washington, DC: Author.

Representatives from the electronics and banking industries have also attempted to outline occupational cluster areas that span a range of technical jobs. As part of their preliminary work, the development task force for the American Electronics Association has identified three entry-level electronics clusters: Administrative/Information Services Specialist, Manufacturing Specialist, and Pre/Post Sales. A comparison of these cluster areas with the taxonomy above suggests that an initial goal of the standard drafting group may have been to identify jobs that fit into the Bureau of Labor Statistics model: the Manufacturing Specialist, Pre/Post Sales and Administrative and Information Support clusters roughly parallel the "Technical, Sales, and Administrative Support" classifications. These cluster areas are composed of four specific jobs with the electronics industry, as shown in Chart 22.

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CHART 22

ELECTRONICS OCCUPATIONAL CLUSTERS

Occupational Clusters	Manufacturing Specialist	Pre/Post Sales	Administrative and Information Services Support
Occupations	Production Associate	Customer Service Representative	Administrative Assistant
	Operator	Service Analyst	Administrative Support
	Production Technician	Field Technician	Secretary
	Assembler	Sales Support Worker	Financial Services

SOURCE: American Electronics Association Work Force Skill Project. (1994). *Setting the Standard: A Handbook on Skill Standards for the High-Tech Industry.* Santa Clara, CA: American Electronics Association.

Within each occupational cluster area, a set of critical functions are defined that describe what must be done in order to fulfill the key purpose of the occupation. These functions cut across job titles and work settings, and in so doing, focus standard development on crucial aspects of the cluster area. For example, in the Manufacturing Specialist cluster, where workers are primarily responsible for the development, manufacture, delivery, and improvement of electronics-related products, seven critical functions have been defined (Chart 23). Each of these functions is in turn broken down into a set of key activities and outcomes that measure if the activity is being performed correctly.

Using a similar process, the California Business Roundtable and the California Department of Education have collaborated to draft a set of banking skill standards for entry-level jobs in three occupational clusters: Data and Item Processing (five occupational clusters), Loan Processing (four clusters), and Sales and Services (five clusters).

The Bioscience National Skill Standards project has taken a slightly different approach to drafting skill standards. Rather than grouping jobs into separate occupational clusters, project staff have instead attempted to identify a single cluster area that captures all the essential skills a technician would need to find employment in the field. To circumvent traditional vocational–technical education stereotypes, members of the Bioscience skill standard project invented the Bioscience Technical Specialist I Learning Occupation. According to project staff, a learning occupation is a group of related work tasks, knowledge, and attributes that are required

CHART 23

MANUFACTURING SPECIALIST

Critical Functions

1) Establish customer needs
2) Initiate and sustain communication processes and procedures
3) Ensure production process meets business requirements
4) Use human resources to manage work flow
5) Select, obtain, and optimize machines and equipment to meet product process requirements
6) Make products that meet customer specifications
7) Determine design workability and manufacturability

Critical Function: Establish Customer Needs

1) Interpret and clarify specifications prepared by others
   - All relevant customer specifications are obtained.
   - When necessary, specifications are confirmed with others for clarity and viability.
   - Specifications are interpreted completely and in a timely manner.
2) Communicate with customer to establish requirements
   - Customer requirements are obtained and documented.
   - Customer is informed if needs cannot be met and alternate recommendations are made.
   - Customer feedback is communicated to relevant specialists.

SOURCE: American Electronics Association Work Force Skill Project. (1994). *Setting the Standard: A Handbook on Skill Standards for The High-Tech Industry.* Santa Clara, CA: American Electronics Association.

to perform a range of job functions in related occupations (Education Development Center 1995). Compiling the skill and knowledge requirements for 19 laboratory-based occupations in the Specialist I occupational cluster, Bioscience staff essentially set the standard for individuals considering career-entry technical positions in the bioscience industry. These include jobs at basic research and clinical laboratories as well as biotechnology and pharmaceutical companies.

Interestingly, Bioscience staff have invented a unique scenario-based approach to skill standards in which students are exposed to a routine work situation and a likely unanticipated problem. A set of 34 scenarios represent the scope of work that students might be expected to perform as a Bioscience Technician, with each scenario presenting students with a typical work responsibility that is complicated by an unanticipated problem. Each skill standard requires students to demonstrate how they would respond to each problem, and provides a list of related information that can assist educators and employers in using the standards for training. As an example of how a scenario-based occupational cluster might be constructed, consider the following skill standard taken from the bioscience manual (Chart 24). In particular, note the key competency areas, tasks, and specific skills, knowledge, and attributes that are provided to assist instructors in assessing students' knowledge.

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CHART 24

INTEGRATED SKILL STANDARDS

SCENARIO 1

One part of your laboratory responsibilities is to safely unpack and process biological samples. Demonstrate everything you would do to accomplish this.

While unpacking samples one morning, you notice that one of the samples is leaking from the container.
According to regulations, what should you do?

TASKS FOR SOLVING PROBLEM(S)

- A-1 Obtain and read protocol, test procedure, SOP
- A-2 Prepare sample for testing
- A-8 Return, archive, or dispose of samples
- C-1 Request tests
- C-2 Match request to test sample
- C-5 Handle, transport, store sample, including legal requirements
- C-6 Assess acceptability/appropriateness of specimen
- F-4 Clean work area according to SOPs
- G-2 Follow universal precautions for biological pathogens
- G-3 Use protective equipment
- G-6 Attend required trainings
- G-7 Handle, contain, and dispose of hazardous materials
- I-1 Inspect, release incoming inventory
- I-2 Check, verify integrity of the product, procedure, specimen
- I-4 Maintain QA logs
- I-5 Follow policies and procedures
- K-1 Interact with vendors, colleagues, and clients
- K-6 Process information using computers
- I-8 Take and document corrective action according to SOP or as directed
- K-7 Notify appropriate persons about problems and observations
- K-8 Document communication of information
- N-8 Maintain professional demeanor

WORKPLACE SETTING(S) FOR THIS SCENARIO

- A) Generic (Applies to B, C, D)
- B) Research and Development ♦
- C) Manufacturing
- D) Clinical Laboratory ♦

KEY COMPETENCY AREA(S) THAT THIS SCENARIO DEMONSTRATES

- Communication (Oral, Written, Electronic)
- Documentation/Tracking
- Performance of Procedure
- Quality Systems (QC, QA)
- Regulatory Compliance
- Safety
- Troubleshooting Methods Failure

SKILLS NEEDED TO PERFORM TASKS

General Work Skills
- Basic Math (Fractions, Percentages, Metric System)
- Communication (Electronic, Oral, Written)
- Critical Thinking
- Decision-Making
- Ethics (Business, Medical, Personal)
- Problem Solving
- Resource Management
- TQM/Total Quality Management

Industry-Related Knowledge
- Anatomy
- Biology/Lab
- Clinical Laboratory Sciences
- Physiology/Lab
- Quality Control and Quality Assurance Practices
- Recognizing Need for Supervisory Assistance
- Regulatory Standards
- Safety Systems
- Terminology (Medical, Bioscience)
- Toxicology

Industry-Related Skills
- Results
- Laboratory Procedures (Basic) Maintaining Records, Logs, Protocols
- Manual Dexterity
- Performance Consistency
- Stress Management
- Troubleshooting Ability
- Upkeep of Equipment/Work Area

ATTRIBUTES

- Accountability
- Alertness
- Common Sense
- Confidentiality
- Conscientiousness
- Courteousness
- Flexibility
- Handles Constructive Criticism
- Hard Working
- Honesty
- Independent Worker
- Integrity
- Interest in Work
- Meticulousness
- Observant
- Positive Attitude
- Professional Attitude/Behavior
- Reliability
- Responsibility
- Safety Consciousness
- Self-Motivation
- Sound Judgment
- Takes Initiative
- Thoroughness
- Willingness to Ask for Help
- Willingness to Work Around Hazardous Chemicals
- Willingness to Work Around Radioactive Materials

SOURCE: Education Development Center, Inc. (1995). *Gateway to the Future: Skill Standards for the Bioscience Industry*. Newton, Massachusetts: Author.

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Reconciling the Models

Cross-industry and industry-specific cluster models can each provide the necessary structure to support the development of a comprehensive skill standard system. Indeed, educators throughout the United States are presently developing and using variations of each model to structure educational programs. Each program offers unique advantages and disadvantages. Cross-industry occupational clusters offer students the opportunity to learn a wide range of skills that can apply across a range of industries and careers. In the emerging high performance workplace, this type of approach may offer both employers and students economic benefits, although lack of skill specificity may give employers less incentive to invest in standard design.

When designing occupational cluster programs for all students, educators may have some incentive to sacrifice skill specificity. Teaching to broad skill standards can increase student motivation to learn if teachers can use standards to better integrate subject matter in a variety of contexts that engage student interest. Moreover, broad occupational clusters can ease the burden of curricular development for teachers who may not have a deep understanding of a specific industry area, and can also increase postsecondary career options for students. Unfortunately, because cross-industry curricular clustering is a relatively new idea, teachers presently have little guidance in identifying skill standards for cross-industry clusters. As a result, academic and career skills are often taught in isolation.

Industry-specific occupational clusters offer a means of teaching basic academic and employability skills outside the traditional vocational education curriculum. Typically, skill instruction is offered in a subset of industry jobs that can help youth prepare for postsecondary education, while outfitting them with a range of skills that can ease work force entry. Since skill standards are contextualized within a specific career theme, industry-specific occupational clusters may reduce students' skill portability. For example, while a student in electronics may develop a range of skills that will prepare him or her for a number of technical, sales, or administrative positions, it is not clear that the skill standards defined for the electronics industry are similar to those in the transportation or health sectors.[3] Moreover, individuals may even have difficulty translating their skills to other occupational areas within the electronics field if skill standards are too narrowly focused on technical aspects.

[3]The National Skill Standards Board (NSSB) is charged with identifying the criteria for selecting industries, occupational clusters, or both that will serve as the basis for a national skill standards system. While the categories proposed in the industry-occupational cluster matrix described in this section are only intended to assist the reader in understanding work that has been performed to date, it is possible that such an organization may ultimately provide a useful way of thinking about the actual development of a national skill standard system.

Although a number of firms are transforming to a high performance workplace, not all employers require broadly trained workers. Many industry-defined occupational cluster programs tend to offer skills that are limited to a single occupational area within a single industry, in part because employers have difficulty finding and retaining trained workers. Until all firms adopt high performance work organizations, industry-specific programs may more closely reflect the skill needs that employers require. As such, it may be difficult to recruit all but the most prescient employers to invest in developing cross-industry standards.

It is likely that occupational clusters will have a significant role to play in the development of a comprehensive skill standard system. Whether clusters are defined broadly so that they incorporate skills across a wide range of industries, or more narrowly within a specific industry area, it is likely that some form of job clustering will be necessary to overcome an otherwise unwieldy task of developing standards for all jobs in all industries. As the following section will show, may skill standards programs exist that presently provide specific occupational skill training within discrete industry and career areas.

OCCUPATIONALLY SPECIFIC STANDARDS

Organizations have long relied on standards to ensure minimum skill competencies among workers. Found in nearly every industrial sector at every skill level, occupationally focused standard systems help determine the knowledge and skills required for employment. Occupational standards also serve as a means of controlling access to the field. Virtually all professional licensing, industry credentialing, and union apprenticeship programs are based on a core set of occupational standards that individuals must meet or exceed to quality for career admission or advancement. This section examines how developers define and implement these standards in practice, and addresses the relationship between education and industry-defined skill standards.

Defining the Occupation

When developers define skill standards using an occupationally specific framework, they often concentrate on what individual workers must know and do to successfully perform a particular job. In some cases, the level of skill proficiency to perform different tasks may also be stated. The key to this approach is that the standards apply to a single occupation that may not be broken down into other independent jobs. While separate occupations may have overlapping skills, every set of job-specific standards stand as a succinct representation of the skills required for success in a specific occupation.

Although the specificity and focus of occupationally specific standards is high, the term "occupation" need not be restrictive. While most skill standards defined within this framework apply to workers whose job is found only in a single industry and particular job area (e.g., agricultural bioscience technician), some standards apply to workers found in several if not all industries (e.g., computer-aided drafting and design). Professions that span a number of industry areas need not yield further occupations within each particular industry setting, but instead may require a worker to obtain additional knowledge and skills for the different applications. For example, a welder may be found working in the construction or the defense industry, but these specializations do not constitute independent occupations in and of themselves.

For many years, professional and industry associations, unions, and states have assumed active roles in governing the processes for both standards and certification. In cases where governance is held by a single organization (i.e., an association), standards systems tend to be

both effective and efficient, although governance may be narrowly focused. While educators and policymakers are increasingly promulgating the need for more broadly defined standards, so far standard-drafting efforts have tended to focus on specific job areas in separate industry spheres. One obstacle has been that when extra-industry representatives are invited to the table concessions must be made to ensure shared influence and control. In order to overcome this obstacle, however, federally funded skill standards projects have needed to involve major stakeholders in drafting standards so that they would reflect national interests. The following discussion briefly describes the nature of governance by associations, organized labor and management, state agencies, and the occupationally specific skill standards projects.

Associations

Professional organizations often have considerable ownership of skill standards, and therefore can self-regulate standard-setting and governance activities, such as generating, validating, updating, and applying training and certification procedures. Board members with positions of authority are elected from the ranks, typically after years of service in which they have learned the requirements for holding a professional degree. In setting standards, these groups often have motives for creating certifications that go beyond the common need to maintain a competent work force. Professional associations, for example, are often concerned with boosting the credibility and reputation of practitioners and with regulating the number of new entrants into their field (Hoachlander 1994). In some instances, controlling the supply of professionals who enter the field has led to heightened income levels for individuals holding valid certification (e.g., doctors and lawyers), but it would be difficult to document this as a base motive for high standards in an occupation.

The American Medical Association and the American Bar Association are among a small number of professional organizations that are governed by a single national association. Individuals wishing to enter the profession must demonstrate their knowledge by completing a rigorous training program and passing a state licensing exam that documents their skill mastery. Both of these requirements are benchmarked to association standards. In contrast, there are more than 20 organizations with standards and certification programs for nurses. Candidates wishing to enter the nursing profession, however, cannot expect to gain broad entrance to the field or to specialized areas by simply meeting the requirements of a single entity, such as the American Nurse's Association. Depending on the area and level of nursing, candidates may be required to complete a master's, bachelor's, or associate's degree, or fulfill a 1-year training program and licensing exam (Wills 1992). For the most part, association-influenced professional standards fall between these examples in that they reflect some shared

control with independent accreditation bodies and a certain level of minimum educational attainment.

In addition, industry associations generate many technical standards. These standards are most frequently put into practice in occupational training programs organized by firms or training organizations that prepare individuals for work at specific firms. Unlike practitioner-dominated organizations, industry associations may invest in employee standards and certification primarily to improve the employer's bottom line or the industry in general, but these are not the only beneficial outcomes. For example, the American Welding Society (AWS) developed standards and programs to certify workers in many levels of the welding field, from Entry-Level Welder to Certified Welder Inspector. One of the expected results of this effort was to save the ironworking industry millions of dollars each year previously spent testing workers' qualifications. An equally significant benefit of these certification programs, however, directly affected the workers. Due to the AWS certification, welders enjoyed greater occupational mobility because their nationally recognized credentials were made more portable (Government Accounting Office 1993).

Apprenticeships

Apprenticeship programs are often developed and run cooperatively by both labor and management representatives to promote and certify the skills and work experience of new entrants to a field. While union apprenticeship programs often stem from standards that are national in scope and lead to skill portability, local programs can also be tailored to meet the demands of specific employers. Although some argue that apprenticeships are too time weighted versus performance based, they provide excellent examples of how industry skill requirements may be used to drive instruction and provide the basis for nationally recognized third-party assessments (Ganzglass and Simon 1995). Perhaps this is one reason craftworkers have enjoyed substantial benefits from certifications, such as ease in obtaining and retaining jobs, higher pay, and increased mobility (Government Accounting Office 1993).

Before 1992, less than half of the more than 800 apprenticeship programs in the country sought assistance from and subsequent formal recognition by the U.S. Bureau of Apprenticeship and Training (BAT) (Wills 1992). The BAT helps to ensure that the standards are comprehensive, nationally representative, and that they do not infringe on other crafts' jurisdictional work areas—all seemingly crucial to affective apprenticeships. Again, the question of influence and control seems to apply. Though BAT approval is both helpful and

prestigious, it also means that programs must meet requirements set, in part, from within the Washington Beltway.

States

Although states vary considerably in their standards and certification programs, in general, state efforts tend to concentrate on specific occupations that directly affect the health or well-being of the public, thus those requiring certification or licensure. These include occupations in the health fields, education, barbering, and cosmetology, as well as occupations in which large sums of money are invested, such as insurance and real estate. In some cases, state agencies will forego the actual development of skill standards, and instead will assign the responsibility for credentialing to a third party of industry practitioners. For example, California's system of cosmetology standards and certification were developed by a state-appointed board of cosmetologists, which sets the school and training curriculum standards and administers the licensing exam. Because the state is responsible mainly for accrediting all private training institutions that train cosmetologists, standards are practitioner driven; however, the resulting credentialing system is a shared responsibility (Rahn, Klein, and Emanuel 1994).

To illustrate the differing practices in state occupational regulation, Chart 25 offers a sampling of occupations and the credentials (if any) that states mandate. Of the three types of credentials, *Licensure* is the most restrictive, granting individuals the "right to practice" the profession and making it illegal to do so without meeting state standards. *Certification* allows individuals the "right-to-title"; that is, others may practice the occupation, but may not use the title unless they meet state requirements. Finally, *Registration*, the least restrictive regulation, requires individuals to file their names, addresses, and qualifications with a government agency before they can practice the occupation.

CHART 25

NUMBER OF STATES REQUIRING LICENSURE, CERTIFICATION, OR REGISTRATION, BY SELECTED OCCUPATIONS

	Licensure	Certification	Registration
Architect	50	0	0
Attorney	50	0	0
Physician	50	0	0
Nurse			
Midwife	27	5	0
Licensed practical	49	0	0
Practitioner	27	3	0
Registered	50	0	0
Horse Race Jockey	0	0	28
Landscape Architect	34	8	1
Security Guard	12	1	9

SOURCE: Council on Licensure, Enforcement, and Regulation. (1994). *The Directory of Professional and Occupational Regulation in the United States and Canada*. Lexington, KY: Author.

Note that in some cases, states place similar emphasis on licensure. In fact, as of 1994, all 50 states required a license for a number of occupations, including architect, chiropractor, paramedic, and real estate broker. In other cases, as with security guards, states had varying occupational requirements. While potential guards must meet licensure standards to practice in a total of 12 states, they are only required to be certified in 1 state and to be registered in 9 states; the remaining 28 states place no occupational restrictions on the position. The high degree of variability among states with regard to which occupations are regulated and to what level has caused many governors to support developing a comprehensive national system of standards and credentials. Without such a system, many fear that the various national, state, and industry standards efforts will continue to develop in different directions and become entrenched in these various approaches (Ganzglass and Simon 1995).

National Skill Standards Projects

The pilot programs sponsored by the U.S. Departments of Education and Labor may be seen as the first systematic effort within industries to cross regional or state barriers and to skirt issues of narrowly held control of standards. In most cases, although an industry association took the lead role as organizer and grant recipient, program governance was shared by cooperative bodies of educators, employers, labor organizations, and experts in their respective fields. Great time and effort was spent convening groups that represented not only all key

stakeholders in the standards but also diverse areas of the country, so that the standards would be national in scope.

Even though federal guidance on coalition building was fairly specific, the specificity and nature of standards was left to the discretion of each project. More than three-quarters of the 22 pilot projects developed standards for specific occupations. One factor in this job-specific trend may be traced to the differing organizational goals and objectives that drove drafting efforts. Discussions with directors of the national industry skill standards projects revealed that half—those funded by the Department of Labor—were instructed to focus on designing "occupational standards that business could use." However, projects funded through the Department of Education received more open-ended instructions. Similarly, standard development in a number of privately funded projects has focused on identifying industry tasks that could be used for certification and professional development within a specific field. Chart 26 lists the national pilot projects that focused on developing occupationally specific skill standards along with the types of occupations for which standards were drafted.

In defining skill standard areas, a majority of projects relied on a modified DACUM (Develop a Curriculum) approach that involved grouping skills and knowledge according to lists of identifiable tasks. Such standards are much more readily used in job-specific training than in more broad-based training programs or general academics. Due to the traditional predominance of occupationally specific training in this country, perhaps the project leaders were considering the most immediate application of the standards, rather than hedging on potential reforms of our work force preparation system.

CHART 26

NATIONAL SKILL STANDARDS PILOT PROJECTS FOCUSED ON OCCUPATIONALLY SPECIFIC STANDARDS

Industry Area	Occupation
Electronics	Entry-Level Electronics Technician Consumer Electronics Technician
Welding	Entry-Level Welder
Uniform and Textile Services	Maintenance Technicians
Hazardous Materials Management	Laboratory/Analytical Technician Compliance/Regulations Technician Field Operations/Remediation Technician Transportation/Storage/Disposal Technician
Photonics	Photonics Technician
Automotive	Automobile Technician Truck Technician Autobody Technician
Agriculture	Agricultural Biotechnology Technician
Air Conditioning, Heating, and Refrigeration	Residential and Commercial Technician
Automobile, Autobody, and Medium/Heavy Truck	Entry-Level Automobile Technician Entry-Level Autobody Technician Entry-Level Truck Technician
Chemical Process	Entry-Level Chemical Lab Technicians Process Technical Operators
Computer-Aided Drafting and Design (CADD)	CADD Users
Electrical Construction	Electrical Construction Worker Electrical Line Construction Worker Electrical Residential Construction Worker
Grocery	Customer Service/Stock Associate Front-End Associate
Heavy/Highway Construction and Environmental Remediation	Construction Craft Laborer
Metalworking	Production Workers Maintenance Technicians
Printing	Prepress/Imaging Technician Press Technician Binding/Finishing/Distributing Technician

Occupational Standards at a Glance

To better understand the nature of job-specific skill standards, it is helpful to see what these standards look like and how they are used in practice. The following section briefly reviews four highly successful occupational skill standard systems, including those developed by government and professional associations.

Pilots

Like many other professions, pilot standards were developed in the interest of public safety; however, unlike most other occupations, aviation standards have been regulated and enforced by the Federal Aviation Administration (FAA) through its Federal Aviation Regulations (FARs). To quality for admission to the field, pilots must master a number of occupational skills, such as airspace and air traffic rules. The competencies required within each area are spelled out in the respective FARs (Wolfe and NewMyer, Aviation Industry Regulation 1985). Chart 27 provides an excerpt from the FAR that applies to the certification of commercial pilots.

CHART 27

FEDERAL AVIATION REGULATION
PART 61

Subpart E—Commercial Pilots

61.127 Flight Proficiency
The applicant for a commercial pilot certificate must have logged instruction from an authorized instructor in at least the following pilot operations:

a) Airplanes
   1) Preflight duties, including load and balance determination, line inspection, and aircraft servicing
   2) Flight at slow airspeeds with realistic distractions, and the recognition of and recovery from stalls entered from straight flight and from turns
   3) Normal and crosswind takeoffs and landings, using precision approaches, flaps, power as appropriate, and specified approach speeds
   4) Maximum performance takeoffs and landings, climbs, and descents
   5) Emergency procedures, such as coping with power loss or equipment malfunctions, fire in flight, collision avoidance precautions, and engine-out procedures if a multiengine airplane is used

SOURCE: U.S. Department of Transportation, Federal Aviation Administration. (1974). *Federal Aviation Regulations*. Reprint, Batavia, Ohio: Sporty's Pilot Shop. 1992.

Pilots-in-training must demonstrate both cognitive and physical skills in a dynamic, even stressful setting. Moreover, they must master a certain number of specific physical tasks, often to strictly measured criteria, in order to physically control an aircraft. Examples of these tasks include the ability to read instruments and react decisively when faced with unique situations and problems. This calls for combining such "immeasurable" skills as problem solving, leadership, judgment, and effective resource management with a solid understanding of meteorology, aerodynamics, aircraft systems, navigation, avionics, and regulations. These abilities and specialized knowledge, when applied creatively to specific situations, are as significant to a pilot's "skills" as physical competencies related to flying a plane, such as banking in the air to make a turn (Hoachlander 1995).

Architects

Architecture is another profession that requires a highly integrated set of skills for effective practice. Like pilots, architects must have the technical skills to perform tasks intrinsic to their work, such as drafting to different scales, as well as the ability to incorporate broad knowledge sets such as structural safety, architectural history, aesthetics, economics, material science, and physics. As the person legally responsible for any design flaws in the built product, the architect must master not only the skills to design and draft plans that construction crews can use but also all applicable building codes, fire regulations, laws, and other ordinances. Decisions based on this knowledge and the demands of the client must coincide with any creative and economic decisions the architect might make (U.S. Department of Labor 1994).

All 50 states and the District of Columbia require architects to be licensed in order to practice. Generally, three requirements must be met to become an architect: a professional degree in architecture, a training period or internship in a place of business, and successful completion of a state's Architect Registration Exam. Skill standards for architects are heavily influenced by the National Council of Architectural Registration Boards (NCARB), a nonprofit corporation composed of all legally constituted architectural registration boards throughout the United States. As developer of the registration exam, NCARB helps determine the knowledge, skills, and abilities that architects are required to master.

The Architect Registration Examination covers eight skill divisions. For each division, the NCARB has developed statements of intent and task lists that delineate the required competencies that candidates must demonstrate. These help candidates prepare for the exam because the questions for each test division are developed to address the tasks listed. Specific tasks relate overarching direction and purpose, and are written at a level allowing wide

interpretation and variability in carrying them out. Since there is no one way to produce correct answers or plans for the exam, the finite steps involved in each action are not specifically defined. Individuals can use the same discretion and independent judgment in applying skills on the exam as they do on the job. Chart 28 illustrates the level of specificity by which skill standards are defined for the exam.

CHART 28

ARCHITECT REGISTRATION EXAM

Skill Areas

- Pre-Design
- Site Design
- *Building Design*
- Structural Technology I
- Structural Technology II
- Mechanical/Plumbing/Electrical Systems
- Materials and Methods
- Construction Documents and Services

Skill Standards: Building Design

Statement of Intent: *The synthesis of programmatic and environmental requirements into a coherent and aesthetic concept through the process of schematic design development*

Tasks:

1) Spatial Organization: Develop drawings that establish the size, location, and features of all programmed spaces and circulation patterns
2) Functional Response: Design each individual programmed space to accommodate the function required
3) Building Efficiency: Recognize net and gross area and/or volume and efficiency requirements in the solution to an architectural program
4) Energy Concepts: Incorporate effective building elements for the conservation of energy and efficient use available energy sources
5) Structural: Show the integration of the selected structural system with the building design
6) Mechanical: Accommodate the appropriate mechanical systems showing their integration with architectural design
7) Building Assemblies: Prepare drawings to illustrate the integration of building assemblies
8) Code Requirements: Incorporate into the building design related code requirements as necessary for the building type and building use
9) Design Intent: Prepare drawings showing the contextual design intent

SOURCE: National Council of Architectural Registration Boards. (1992). *Circular of Information No. 2 Architect Registration Examination*. Washington, DC: Author.

Automobile Technicians

Skill standards for automobile technicians emerged in the late 1960s following widespread public complaints about poor repair service. Federal hearings on the issue revealed that in most instances, incompetence, and not fraud, was a contributing factor. Rather than wait for Federal

action, the National Auto Dealers Association and the Motor Vehicle Manufacturers Association created the Automotive Service Excellence (ASE) program to create national standards for training and certifying automotive repair workers (Hoachlander and Rahn 1994). The resulting standards form the basis of a national system to evaluate automobile mechanic training programs. Those programs that meet association guidelines receive ASE certification and the right to certify graduates. As a part of ASE, the National Automotive Technicians Education Foundation (NATEF) has been administrating the evaluation process and, as of October 1995, has certified 968 automobile programs throughout the country.

In 1992, NATEF was awarded one of the 22 federal standards grants to review and update its current standards. A secondary goal was to identify the applied language arts, math, science, electronics, and employability skills that are also required of technicians. In addition to the automobile standards, the project addressed those for Medium/Heavy Trucks and Autobody Repair. Chart 29 illustrates both task list groupings and the applied academic and workplace skills that pertain to all groups.

The ASE standards have done far more than simply avert federal intrusion. They have brought credibility to occupations (as well as their employers) previously suspect to the general public. Repair shops and certified technicians conspicuously display their ASE placards and patches, and many automotive service stations specifically mention that they employ ASE certified technicians in radio and television advertisements. The automotive technician skill standards have resulted in an "everyone wins" situation—workers have stronger, more marketable skills; employers have knowledgeable, reputable employees; and the public receives higher quality service for their money.

CHART 29

ASE AUTOMOBILE TECHNICIAN SKILL STANDARDS

Task List Groups

- Engine Repair
- Manual Drive Train and Axles
- Electrical/Electronic Systems
- Engine Performance
- Automatic Transmission/Transaxle
- Suspension and Steering
- Heating and Air Conditioning
- Brakes

Samples of Engine Repair Tasks

Perform engine vacuum tests; determine needed repairs
Remove engine (front-wheel drive); prepare for tear down
Inspect and test valve springs for squareness, pressure, and free height comparison; replace as needed
Check valve spring assembled height and valve stem height; service valve and spring assemblies as needed
Inspect and replace pans, covers, gaskets, and seals
Deglaze and clean cylinder walls
Clean, inspect, test, and replace fan(s) (electrical or mechanical), fan clutch, and fan shroud

Samples of Applied Academics and Workplace Skills

Language Arts: Adapt a reading strategy for all written materials (e.g., customer's notes, service manuals, shop manuals, technical bulletins, etc.) relevant to problem identification, diagnosis, and repair.
Math: Calculate the average (mean) of several measurements to determine the variance from the manufacturer's specifications.
Science: Demonstrate an understanding of how fuel characteristics affect combustion in an auto engine.
Demonstrating Team Work: Identify the style of leadership used in team work; match team member's skills and group activity; work with team members; complete a team task; and evaluate outcomes.

SOURCE: National Automotive Technicians Education Foundation, Inc. (1993a). *ASE Program Certification Standards Automobile*. Herndon, VA: Author.

Welders

Rather than simply generate a group of skill lists and competencies, the American Welding Society drafted occupational standards that actually resemble a training guide. Suggested training modules, activities, and notes throughout its document are intended to assist providers in secondary, postsecondary, or employer-based training programs in building new programs or enhancing existing ones. Although use of the guide for teaching welding skills is voluntary, groups desiring to certify trainees as an AWS Certified Entry-Level Welder are required to use the Society's training and qualification guidelines. An example from the recently completed standard is provided in Chart 30.

CHART 30

WELDING TECHNICIAN SKILL STANDARD

Learning Objective #4: *Operate manual oxyfuel gas-cutting equipment*

Performance Conditions: Provided with a period of instruction and demonstration, protective clothing and equipment, manual oxyfuel gas-cutting equipment and accessories, oxygen/fuel gas supply systems and accessories, hand tools, base metal, and a cutting assignment in the work area

Desired Behavior: The trainee will perform manual oxyfuel gas-cutting operations

Evaluation Criteria: The trainee's cutting is completed as required by the cutting assignment. During and after the operation, cut surfaces are visually examined by the trainee and accepted by the instructor. The objective is performed on a routine basis during the length of the program. In accordance with the requirements of AWSWC10, the trainee shall pass the oxyfuel gas-cutting principles of operation and common process variables portion of a summative closed book examination from the related sections of ANSI/AWS C4.2, *Operator's Manual for Oxyfuel Gas Cutting*.

SOURCE: American Welding Society. (1995). *Guide for the Training and Qualification of Welding Personnel-Entry Level Welder*. Miami: Author.

Occupationally Specific Standards in Education

Occupational standards directly affect how educational programs prepare students for certification or licensure and for jobs with particular employers via customized training. In this way, standards are responsive to industry needs and often translate directly into content and hour requirements for individual courses. While this confers an advantage to students who wish to meet state licensure requirements or work for a particular local employer, it may impose limitations on students in the long term, because when occupational skills change, workers may be required to begin training essentially from scratch. And those who lack a broad skill base may have difficulty adapting to new workplace technology and skill demands.

As an example of how vocational programs may be structured to incorporate skill standards into the curriculum, consider programs offered at the United Technical Center (UTC) in Clarksburg, West Virginia. As a regional vocational high school, UTC provides specialized vocational coursework to students who split their attendance at the facility and their home academic high school. Comparing the offerings of this institution to the selected skill standards projects in Chart 26, the direct application of standard to curriculum is apparent. Students at UTC may select from a range of 15 specialized certification programs, including the following:

- Administrative Systems
- Auto Body Technology
- Auto Technology
- Building Construction
- Cosmetology
- Drafting Technology
- Electrical Technology
- Health Assistant I
- Health Assistant II
- Electronics Technician
- Licensed Practical Nursing
- Machine and Metals Technology
- Welding
- Printing Technology

As part of their Welding coursework, for example, students complete 1,080 hours of instruction using modern equipment. Studies are intended to prepare students for entry-level careers in the welding field, with instruction benchmarked to the latest changes in technical knowledge. Students choosing to focus their studies may graduate with a state certificate in welding, and if they desire, attend a local community college where they may apply up to 16 hours of credit toward an Associate Degree in Welding Technology or a Welding Management Technical degree. National standards developed by AWS for Entry-Level Welder would be invaluable to programs such as this, where standards may be used by instructors to keep pace with technological trends in the industry, to improve skill portability, and to drive program improvement.

Vocational skill standards may also be drafted at the state level to drive the development of common statewide curriculum. One such effort is the New Jersey Occupational Competencies Project, designed to develop statewide standard competency lists that identify the skills employers expect entry-level workers to possess within 6 months of starting the job. Intended as a resource for curriculum and instruction in vocational programs at the secondary and adult levels, competency lists identify the specific duties and tasks required of entry-level workers, as well as the related academic and employability skills. Skill-drafting groups, composed of workers and supervisors from the field, review proposed standards, and then an educator panel reviews lists and identifies related academic skills.

As one of its first steps, the state working group has clarified the essential competencies and academic and employability skills required of shipping and receiving clerks (Chart 31). These competency lists are intended to assist curriculum developers in planning topics, designing instructional strategies, and planning activities and evaluation criteria. The primary objective of these lists is to benchmark the teaching of vocational programs to industry standards. As stated in the guide, a curriculum developer who uses the state competency lists can be assured that ". . . the resulting teaching and student materials will be up-to-date and relevant to the skills needed by program completers as they begin employment in the occupation" (New Jersey Occupational Competencies Project 1994).

CHART 31

SHIPPING AND RECEIVING CLERK

Specific Duties

- Maintain the store/warehouse/mailroom
- Receive and store goods
- Assemble, pack, and ship goods
- Perform service functions
- Perform supervisory functions
- Perform administrative functions

Academic Competencies

- Entrepreneurship/free enterprise
- Language arts
- Mathematics
- Science

Generic Employability Skills

- Making career decisions
- Using labor market information
- Using job application skills
- Demonstrate positive work behavior
- Demonstrate reliable work behavior
- Demonstrate positive work attitudes
- Exhibiting good interpersonal skills
- Maintain a professional image
- Maintain a safe and healthy workplace
- Adapting to change
- Communicate on the job

SOURCE: New Jersey Occupational Competencies Project. (1994). *New Jersey Occupational Competency List for Shipping and Receiving Clerk.* Aberdeen, NJ: Author.

Youth Apprenticeship programs combine structured classroom and work-based learning to provide students with industry-recognized skills. In these programs, instruction is typically offered via articulated secondary and postsecondary programs that begin in the 11th grade and continue through at least 1 year of postsecondary education. One of the most important aspects of youth apprenticeship is that instruction is structured so that completers receive some form of credential that attests to both occupational and academic skill mastery. To ensure that skill

instruction relates to the workplace, standards are usually developed with input from business and industry representatives.

The Fox Cities Printing Youth Apprenticeship program in Appleton, Wisconsin, sheds light on how standards may be integrated into classroom instruction. Developed with the assistance of a vice president at a large printing firm and the district school superintendent, the Fox Cities program offers students an opportunity to specialize in lithographic or flexographic printing techniques by the end of their second year of program participation. To ensure that coursework relates to industry needs, a competency-based printing curriculum has been developed to guide classroom and worksite instruction. Skills identified by the Printing Industries of America, as well as those identified by industry experts, are used to design a program that offers students wide exposure to the printing industry (Pauley et al. 1994). Apprentices successfully completing the program are awarded a Certificate of Occupational Proficiency by the Wisconsin Department of Industry, Labor, and Human Relations.

While not all youth apprenticeship programs rely on industry-developed skill standards to structure coursework, in general, programs are often overseen by broad coalitions that include business partners. Examples of the types of programs in which youth apprenticeships may currently be found include aerospace, metalworking, health careers, business management, graphic arts, and construction. In addition to Wisconsin, statewide initiatives are also ongoing in Arkansas and Pennsylvania (Stern et al. 1994).

Customized Programs

The needs of local or regional employers can be met when they collaborate with vocational educators to customize training. Partnerships between employers and educational institutions can very effectively set skill standards designed to prepare individuals for both a particular occupation and the special needs of a company actively seeking workers. One such partnership exists in the micro-processor industry, where Intel Corporation and two educational institutions in Oregon are working to provide employees and students with a path to higher education and career positions, while supplying Intel with the skilled work force it needs. As the industry and Intel's operating procedures have changed, so has the work of its employees and new hires. For example, in an effort to keep up with industry advances and corresponding changes in production processes, Intel has consolidated the Maintenance Technician, Process Technician, and Operator occupations into one job—Manufacturing Technician.

Major changes like this require modifications in how workers train and how students prepare for the new position. For example, continuous learning and higher levels of competence are now expected. Chart 32 shows the subject areas that reflect skill standards within the curriculum for one of the points on this learning path—an Associate degree in Semiconductor Manufacturing Technology.

CHART 32

SEMICONDUCTOR MANUFACTURING TECHNOLOGY

Subject Areas

• Mathematics • Chemistry • Physics • Electronics • Electromechanical Skills
• *Semiconductor Manufacturing* • Teamwork • Oral and Written Communication
• Computer Concepts, Systems, and Applications • General Education

Semiconductor Manufacturing Courses

• *Semiconductor Manufacturing Overview and Process Flow*
• Facilities • Shop Floor Control • Metrology • Material Science

Semiconductor Manufacturing Overview and Process Flow—Topics

• History of the Semiconductor Industry • Semiconductor Materials • *Oxidation*
• Photolithography • Etch • Doping • Deposition
• Metallization • Water Test and Packaging

Oxidation

Discuss the growth and use of silicon dioxide layers in the manufacture of integrated circuits:

1) Uses of silicon dioxide layers
2) Thermal oxidation mechanisms and methods
3) Oxidation processes
4) Post-oxidation evaluation

SOURCE: Sematech Technician Training Curriculum Task Force. (1995). *Final Report 1995*. Portland: Author.

Articulation agreements aid both current Intel employees and newly graduated seniors to complete job specific training, an Associate degree in Applied Science/Microelectronics Technology, and finally, a Bachelor of Science degree in Manufacturing Engineering Technology. This industry/education partnership helps to ensure that there is agreement between employers and educators on what students need, as well as helps to integrate academic and career instruction in a system of continuous learning (SEMATECH 1995).

Implications for Educational Programs

Occupationally specific skill standards have evolved in the United States over many years and have helped shape our work force education and training systems. They not only have helped professional trainers and educators to build a strong public image for practitioners, but also have played a significant role in their systems of career-long learning and advancement. On the other hand, occupational standards may be a detriment to other workers' careers. For technical workers, a high level of skill specificity may lead to immediate job placement, but it may narrow later career opportunities, leaving these workers at a disadvantage if their firm incorporates high performance work practices.

CONCLUSION

This research synthesis described and analyzed different approaches to conceptualizing and implementing skill standards. Evidence suggests that nearly all national, state, and private-sector drafting efforts fit into one of four frameworks—general work readiness, industry, occupational cluster, or occupational specific—that describe the type of skill standards and the context in which they are implemented. Examples of educational skill standard models that fit each framework were also observed.

Efforts to design standard systems are proceeding along a skill continuum (Chart 33). At their most general level, skill standards describe broad work force readiness skills that all workers need for labor market success. These include basic academic and cognitive skills that underlie all career areas, as well as more advanced personal and teamwork skills that prepare an individual to cope with workplace issues. Industry skills and knowledge describe a core group of standards that help individuals comprehend the range of opportunities available within an industry area. On the other hand, occupational cluster and specific occupational skills describe a more narrow set of standards that a worker would need to master in order to find a job within a group of related occupations or a specific occupational field. Obviously, from the examples described in various sections of this research synthesis, the four types of standards are not mutually exclusive: there is considerable overlap of skills and terminology across standard development projects.

While skill standard development within the typology may have a similar objective—to prepare youth for continued educational growth and economic success—the goals and techniques to reach this objective differ. Different types of standards can be used for career advancement, entry-level certification, curriculum improvement, and other educational or economic purposes. Similarly, employers, educators, and professional and labor organizations all have different goals for skill standards that may influence what they eventually develop. For example, many employers may be interested in developing certification systems that signal specific occupational skills that students have mastered, while academic teachers may be more interested in improving the academic performance of their students before graduation. Although each group may have valid reasons for creating specific types of skill standards, efforts to develop standards in isolation complicate the development of a national skill standard system.

CHART 33

SKILL STANDARD CONTINUUM
EXAMPLES FROM THE HEALTH INDUSTRY

General work force preparation	Industry core skills and knowledge	Occupational cluster skills	Specific occupational skills
ALL WORKERS ⇩	HEALTH SERVICES ⇩	HEALTH INFORMATION SERVICES ⇩	HEALTH INFORMATION TECHNOLOGISTS ⇩
• Read, write, perform math operations; listen and speak • Apply basic and advanced academics in the work setting • Participate as a member of a team	• Be aware of the history of health care • Use health care terminology	• Locate information in medical records • Use computer programs to process client information	• Evaluate medical records for completeness and accuracy • Use a computer program to assign patients to a diagnosis-related group

SOURCE: MPR Associates, Inc. (1995). *School-to-Work Opportunities Glossary of Terms*. Berkeley: Author.

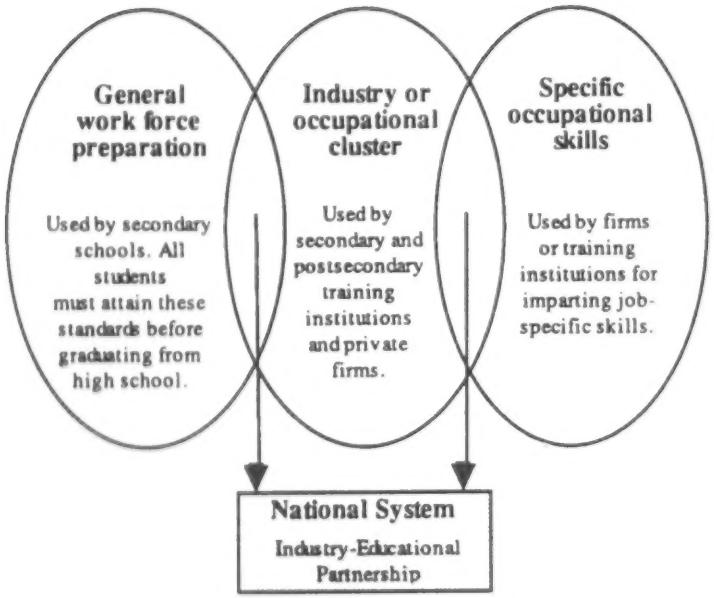
To date, most standard-drafting efforts have concentrated on defining skills that relate to a specific occupation or cluster of related occupations within a specific industry area. This may be due, in part, to employers' desire to find and recruit skilled workers, particularly since many entry-level jobs are plagued by high turnover. It is also a much simpler process to define specific task standards required for a single occupation than for a range of careers that span an industry area. While creating focused skill standards can help employers recruit trained workers for industry jobs that are difficult to fill, unless skill identification is sufficiently broad, standard-drafting efforts will fail to address high performance workplace issues. Moreover, when standards are too narrowly defined, educators are unable to link classroom instruction to proposed skills. The danger, then, is that industry-drafting projects risk creating a separate system that will be impossible to link to a national system.

Educators are most often concerned with student mastery of broad-based academic knowledge and work-related skills. To help drive curricular development, a number of national, state, and professional groups are presently at work deriving academic and general work force readiness skill standards. It is primarily in the public interest that these basic skill standards are developed, in part because they can help students make better training and postsecondary decisions, and also because they can motivate students to increase their educational attainment.

Employers are typically more concerned with individuals' preparation for work force entry (and career advancement). As such, a large number of private-sector groups are working to develop occupationally specific skill standards that target particular jobs within an industrial area. It is primarily in the private interest to develop these standards, since occupationally specific training will benefit employers by reducing training and maximizing labor productivity.

CHART 34

SKILL STANDARD TAXONOMY


General work force preparation
Used by secondary schools. All students must attain these standards before graduating from high school.
Industry or occupational cluster
Used by secondary and postsecondary training institutions and private firms.
Specific occupational skills
Used by firms or training institutions for imparting job-specific skills.
National System
Industry-Educational Partnership

SOURCE: Rahn, M., S. Klein, and D. Emanuel. (1994).

While educational and industry approaches may differ in how they define standards, the two do not have incompatible goals, and, in fact, may only represent different starting points on the same continuum. Indeed, it is possible that independent work within each framework may be necessary before development of a national skill standard system actually begins. Although the eventual shape of the system has yet to be determined, it is likely that the development process may begin with the integrating of industry and occupational cluster areas to provide a context for instruction. Lying at the center of the continuum, industry and occupational cluster

standards balance private-sector interests in specific skill training against the public's interest by assuring that everyone has access to a basic educational foundation (Chart 34). Irrespective of whether the system emphasizes industry or occupational cluster themes, system design will require input from representatives of education, business, labor, and industry, and will also require a clear understanding of the goals and objectives of standard development.

The struggle in developing a comprehensive skill standard system for education lies in finding an appropriate balance between specific and general industry skills. Regardless of the type of skill standard system adopted, instruction must be broad enough to expose all youth to a wide range of careers so that they understand all the different opportunities available to them. This means that in addition to entry-level training, youth must be exposed to more advanced career opportunities and the skills required to obtain them. At the same time, training must provide measurable, portable skills, benchmarked to world class levels, that will enable students to demonstrate standard mastery to postsecondary educators and employers.

Often standard developers fail to ask themselves the appropriate questions before beginning their efforts: What type of skills should be developed first? Who should set standards? How should standards be assessed? How does one set of standards fit with another? When such issues are overlooked early in the process, a variety of efforts result that do not facilitate forming a "system" of standards for state and local entities. Although there are some very good examples of "types" of standards, few, if any, "systems" integrate the four types of standards presented in this synthesis. Ultimately, the organization of standard-drafting efforts must reflect the purposes for which the system is intended, or put another way, form must follow function.

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Appendix A:

SCANS' Skills

A THREE-PART FOUNDATION

Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks

A. *Reading*–locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules
B. *Writing*–communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts
C. *Arithmetic/Mathematics*–performs basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques
D. *Listening*–receives, attends to, interprets, and responds to verbal messages and other cues
E. *Speaking*–organizes ideas and communicates orally

Thinking Skills: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn, and reasons

A. *Creative Thinking*–generates new ideas
B. *Decision Making*–specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative
C. *Problem Solving*–recognizes problems and devises and implements plan of action
D. *Seeing Things in the Mind's Eye*–organizes, and processes symbols, pictures, graphs, objects, and other information
E. *Knowing How to Learn*–uses efficient learning techniques to acquire and apply new knowledge and skills
F. Reasoning–discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem

Personal Qualities: Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty

A. *Responsibility*–exerts a high level of effort and perseveres towards goal attainment
B. *Self-Esteem*–believes in own self-worth and maintains a positive view of self
C. *Sociability*–demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings
D. *Self-Management*–assesses self accurately, sets personal goals, monitors progress, and exhibits self-control
E. *Integrity/Honesty*–chooses ethical courses of action

FIVE COMPETENCIES

Resources: Identifies, organizes, plans, and allocates resources

A. Time–selects goal-relevant activities, ranks them, allocates time, and prepares and follows schedules
B. Money–uses or prepares budgets, makes forecasts, keeps records, and makes adjustments to meet objectives
C. *Material and Facilities*–acquires, stores, allocates, and uses materials or space efficiently
D. *Human Resources*–assesses skills and distributes work accordingly, evaluates performance and provides feedback

Interpersonal: Works with others

A. *Participates as Member of a Team*–contributes to group effort
B. *Teaches Others New Skills*

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C. *Serves Clients /Customers*–works to satisfy customers' expectations
D. *Exercises Leadership*–communicates ideas to justify position, persuades and convinces others, responsibly challenges existing procedures and policies
E. *Negotiates*–works toward agreements involving exchange of resources, resolves divergent interests
F. Works *with Diversity*–works well with men and women from diverse backgrounds

Information: Acquires and uses information

A. *Acquires and Evaluates Information*
B. *Organizes and Maintains Information*
C. *Interprets and Communicates Information*
D. *Uses Computers to Process Information*

Systems: Understands complex inter-relationships

A. *Understands Systems*–knows how social, organizational, and technological systems work and operates effectively with them
B. *Monitors and Corrects Performance*–distinguishes trends, predicts impacts on system operations, diagnoses deviations in systems' performance and corrects malfunctions
C. *Improves or Designs Systems*–suggests modifications to existing systems and develops new or alternative systems to improve performance

Technology: Works with a variety of technologies

A. *Selects Technology*–chooses procedures, tools or equipment including computers and related technologies
B. *Applies Technology to Task*–understands overall intent and proper procedure for setup and operation of equipment
C. *Maintains and Troubleshoots Equipment*–prevents, identifies, or solves problems with equipment, including computers and other technologies

For more information, *What Work Requires of Schools: A SCANS Report for America 2000, The Secretary's Commission on Achieving Necessary Skills*, U.S. Department of Labor, June 1991.